APDIO

ASSOCIAÇÃO PORTUGUESA DE INVESTIGAÇÃO OPERACIONAL

XXI CONGRESSO

Figueira da Foz

7 a 8 de novembro | 2021

io2021

ANALYTICS FOR A BETTER WORLD

LIVRO DE RESUMOS

Editado por

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XXI Congresso da Associação Portuguesa de Investigação Operacional

Livro de Resumos

Editores:

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7 e 8 de novembro 2021

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Mensagem do Presidente da Direção da APDIO

"E se fizéssemos o Congresso num hotel?..."

Foram estas palavras que no início de abril, ainda o país estava sob um regime de mobilidade limitada, desbloquearam a realidade que hoje estamos a viver: o Congresso da APDIO â IO 2021. A Direção da APDIO queria promover um encontro da comunidade de Investigação Operacional, que sentia como desejado e necessário. Mas, apesar da esperança que o processo de vacinação nos trazia, os tempos ainda eram de elevada incerteza, os estabelecimentos de ensino superior estavam a funcionar em modo remoto, e as limitações aos eventos eram numerosas e fortes. A solução segura para o nosso congresso seria o modo online, e chegamos a planear um congresso online espalhado no tempo, mas estávamos todos saturados de Zoom. Queríamos fazê-lo em modo presencial. Tudo nos empurrava para adiar a decisão, mas um congresso requer a realização de preparativos com bastante antecedência. Mas como, quando nenhuma instituição de ensino superior nos cederia instalações?

"E se fizéssemos o Congresso num hotel?... Como o INFORMS faz."

De repente, muitos impossíveis passaram a estar ao alcance das nossas decisões. A escolha de uma data de Outono, época baixa hoteleira, baixava os custos do evento. Decorrendo o congresso num hotel poderíamos ter todos os participantes alojados no mesmo local, maximizando a interação e a partilha. Um local na zona centro do país facilitaria as deslocações. Mas um congresso em pleno semestre letivo não poderia ser longo. Então faziamo-lo ao longo de apenas dois dias, o primeiro dos quais um domingo. E assim, passo a passo chegámos ao IO 2021, no Hotel Eurostars Oasis Plaza, 7 e 8 de novembro.

Mas um problema neste formato de congresso parecia intransponível: não dispondo de salas para sessões paralelas, pelos custos incomportáveis que acarretariam, como ter as habituais dezenas de apresentações em apenas um dia e meio? Transformando dificuldades em oportunidades, lançou-se a ideia de todas as apresentações serem sob a forma de poster, promovendo e treinando competências de comunicação científica, com o envolvimento dos próprios participantes na votação de quais os posters que seriam alvo de uma curta apresentação, seguida de discussão. Pecha Kucha, timer, sistemas de votação, formatos, A1, A0, A2, foram termos e palavras que voaram pelos ares até se chegar ao modelo de congresso que hoje vamos tornar vivo. A adesão da comunidade de Investigação Operacional, com mais de 80 posters submetidos e cerca de 130 participantes no congresso, foi extraordinária e faz-nos acreditar que a aposta foi ganha.

Como é habitual nos congressos, procurámos um tema. Mas o momento histórico que vivíamos tornava óbvia a escolha: "Analytics for a Better World". E aqui temos que agradecer vivamente aos nossos palestrantes convidados. O colega Manuel Matos irá falar-nos da incerteza nos processos de decisão. Sabemos que a incerteza é mais a regra do que exceção, mas tem especial impacto quando vidas humanas estão em jogo, em aplicações de logística humanitária, ou na gestão de desastres. E este é o dia a dia do Eng. Sérgio Guedes Silva, que lidera a equipa de gestão da cadeia de abastecimento da World Food Program (WFP), a partir do quartel-general da WFP em Roma, e que nos falará sobre "The power of analytics in a Humanitarian Context". Missão igualmente sensível foi a que o Sr. Vice-Almirante Gouveia e Melo assumiu, ao liderar a task-force que em Portugal geriu o processo de vacinação contra a COVID-19. Para bem de Portugal, o sucesso do seu trabalho foi avassalador. Queremos acreditar que o facto de ter sido a Marinha de Portugal a introduzir em Portugal o ensino da Investigação Operacional, há mais de 50 anos, não tenha sido alheio a este sucesso. Por isso, quisemos ouvir do Sr. Vice-Almirante os principais desafios enfrentados e as lições aprendidas neste processo. A pandemia teve impactos inesperados em vários setores da economia, mas a logística é uma das atividades que ainda hoje está mais afetada e sem solução à vista para a disrupção sofrida. A gestão das cadeias de abastecimento é a área de trabalho do Pedro Amorim, e é a partir desta aplicação que irá refletir sobre como podemos alavancar a relevância prática da nossa investigação em Investigação Operacional. Mais uma vez, estamos muito gratos aos quatro palestrantes por terem aceitado o nosso convite e é com muito interesse que os iremos ouvir.

Acredito que a complexidade e incerteza associada à organização deste congresso terão ficado claras nas minhas palavras anteriores. Por isso mesmo, a Direção da APDIO não podia pedir a ninguém para organizar o congresso, tinha que o fazer ela própria. Foi assim que assumimos o papel de Comissão Organizadora. Foi assim que se passaram faturas, se geriram recebimentos, se fez o site e geriu toda a comunicação, se prepararam templates e se fez o livro de resumos, se arrendaram salas, contrataram refeições e se construiu um programa social. Enfim, tudo o que é habitual numa conferência foi tratado pela Cristina, pela Carla, pela Maria Antónia e pela Ana, superiormente coordenados pelo incansável Samuel, a quem todos devemos uma salva de palmas: ele foi a alma e o músculo desta organização. Obrigado a todos.

Finalmente, um agradecimento muito profundo a todos os colegas da Comissão de Programa (que terão ainda a tarefa de rever os artigos que serão publicados no livro do congresso, editado pela Springer), e das comissões dos vários prémios que teremos este ano. A vossa colaboração foi fundamental para o sucesso deste modelo de congresso.

Caros sócios da APDIO. Este é o último congresso em que me dirijo a vós, enquanto Presidente da Direção da APDIO. Por isso, gostava de deixar uma palavra de agradecimento por terem confiado em mim para conduzir os destinos da associação durante 6 anos. A quem me venha a suceder só posso dizer uma coisa: Não se preocupem! Dirigir uma associação com pessoas com a qualidade, a dedicação, o entusiasmo e o empenho que os sócios da APDIO têm, é muito fácil.

E agora, vamos começar o congresso!

Figueira da Foz, 7 de novembro de 2021

José Fernando Oliveira
Presidente da Direção da APDIO

Nota do Presidente da Comissão de Programa

É com enorme satisfação que recebemos a vossa participação no maior evento nacional de Investigação Operacional. Com mais de 120 participantes inscritos e cerca de 80 trabalhos submetidos, o IO2021 vem dar assim continuidade à nossa importante missão de comunicar, divulgar e abordar problemas complexos que impactam a nossa sociedade, economia e ambiente. Apesar da investigação de excelência que tem vindo a ser desenvolvida, os problemas maiores continuam por resolver e, por isso, quisemos com o IO2021 desafiar a nossa comunidade a apresentar modelos, metodologias e novas perspetivas de análise que indiquem caminhos para um mundo melhor.

Tempos diferentes exigem abordagens diferentes. Reinventamos o Congresso da APDIO, num programa mais concentrado que visa inspirar os mais novos e seja facilitador de produção de conhecimento entre pares. Teremos um dia e meio de congresso com apresentações plenárias e mesas redondas, que se realizarão sempre no mesmo espaço. O dia de domingo será reservado a dois oradores destacados, o Vice-Almirante Gouveia e Melo e o Eng. Sérgio Guedes Silva, e à discussão e votação dos posters. Nas plenárias de segunda-feira, teremos os Professores Manuel Matos e Pedro Amorim, e um total de 25 apresentações de trabalhos num formato de mesas redondas. Um agradecimento muito especial aos oradores convidados pela disponibilidade e contributo. Publicamos ainda o Livro de Resumos dedicados ao XXI Congresso da Associação Portuguesa de Investigação Operacional. Pós-congresso, os artigos aceites no processo de revisão serão publicados nos Springer Proceedings in Mathematics Statistics.

Gostaria de deixar uma palavra de apreço a todos os elementos da Comissão Organizadora, Isabel Cristina Lopes, Carla Geraldes, Maria Antónia Carravilla, Ana Paula Barbosa Póvoa e José Fernando Oliveira, pelo espírito de equipa inabalável que permitiu superar os desafios da conjuntura atual. Saliento, também, o apoio do Departamento de Engenharia Mecânica da Faculdade de Ciências e Tecnologia da Universidade de Coimbra.

Desejamos que o programa científico e social vá de encontro às melhores espectativas e que o IO2021 seja um evento marcante na nossa comunidade.

Figueira da Foz, 7 de novembro de 2021

Samuel Moniz

Presidente da Comissão de Programa

Comissão Organizadora

Samuel Moniz, Universidade de Coimbra (Presidente)

Isabel Cristina Lopes, Instituto Politécnico do Porto

Carla Soares Geraldes, Instituto Politécnico de Bragança

Maria Antónia Carravilla, Faculdade de Engenharia da Universidade do Porto

Ana Paula Barbosa-Póvoa, Instituto Superior Técnico, Universidade de Lisboa

José Fernando Oliveira, Faculdade de Engenharia da Universidade do Porto

Comissão de Programa

Samuel Moniz, Universidade de Coimbra (Presidente)

Agostinho Agra, Universidade de Aveiro Departamento de Matemática

Ana Cristina Amaro, Instituto Politécnico de Coimbra ISCAC | Coimbra Business School

Beatriz Oliveira, Universidade do Porto Faculdade de Engenharia

Carla Soares Geraldes, Instituto Politécnico de Bragança

Cláudio Alves, Universidade do Minho Escola de Engenharia

Cristóvão Silva, Universidade de Coimbra

Eliana Costa e Silva, Instituto Politécnico do Porto Escola Superior de Tecnologia e Gestão

Filipe Alvelos, Universidade do Minho Escola de Engenharia

Gonçalo Figueira, Universidade do Porto Faculdade de Engenharia

Isabel Cristina Lopes, Instituto Politécnico do Porto Instituto Superior de Contabilidade e Administração

Isabel Gomes, Universidade Nova de Lisboa Faculdade de Ciências e Tecnologia

João Patrício, Instituto Politécnico de Tomar Escola Superior de Tecnologia de Tomar

João Paulo Almeida, Instituto Politécnico de Bragança

Lia Oliveira, Instituto Politécnico de Viana do Castelo Escola Superior de Ciências Empresariais

Maria Cândida Mourão, Universidade de Lisboa Instituto Superior de Economia e Gestão

Maria Eugénia Captivo, Universidade de Lisboa Faculdade de Ciências

Maria João Alves, Universidade de Coimbra Faculdade de Economia

Miguel Vieira, Universidade Lusófona

Rui Borges, Universidade de Aveiro

Sofia Miranda, NPS Alumni, US Naval Postgraduate School

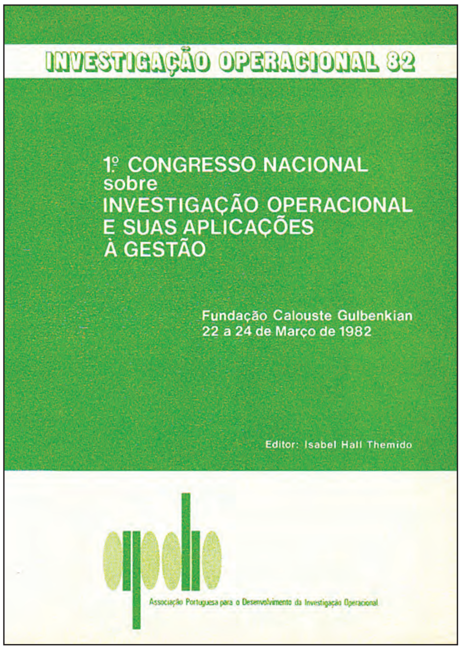
Susana Relvas, Universidade de Lisboa Instituto Superior Técnico

Tânia Ramos, Universidade de Lisboa Instituto Superior Técnico

Telmo Pinto, Universidade de Coimbra

Teresa Cardoso Grilo, Instituto Universitário de Lisboa ISCTE Business School

Edições Anteriores



1º Congresso da APDIO

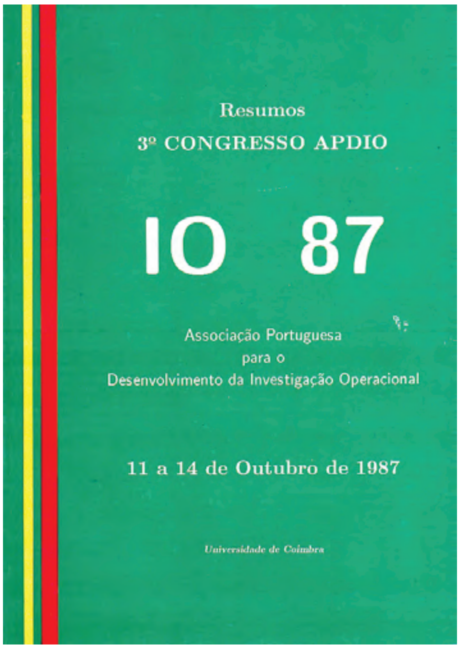
Lisboa, 22 a 24 de março de 1982
Fundação Calouste Gulbenkian

Presidente da Comissão Organizadora
Aníbal Durães Santos

2º Congresso da APDIO

Porto, 16 a 18 de abril de 1984
Faculdade de Economia da Universidade do Porto

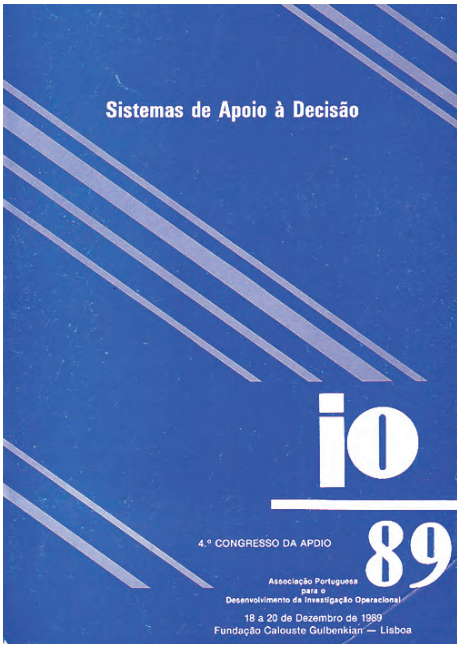
Presidente da Comissão Organizadora
Rui Guimarães



3º Congresso da APDIO

Coimbra, 11 a 14 de outubro de 1987
Universidade de Coimbra

Presidente da Comissão Organizadora
Mário da Silva Rosa



4º Congresso da APDIO

Lisboa, 18 a 20 de dezembro de 1989
Fundação Calouste Gulbenkian

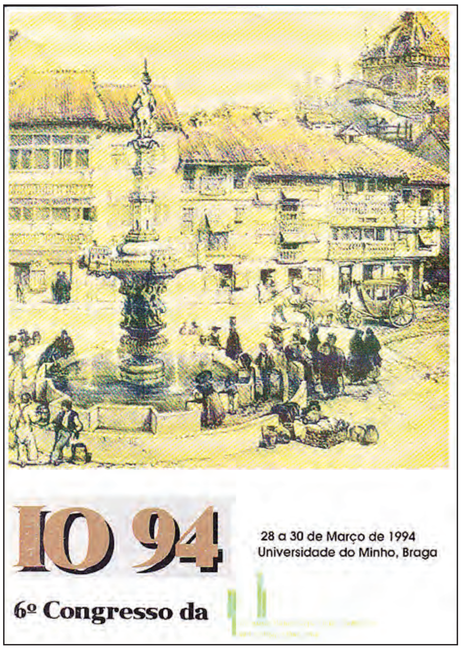
Presidente da Comissão Organizadora
A. J. Simões Monteiro

5º Congresso da APDIO

Évora, 13 a 15 de abril de 1992
Universidade de Évora

Presidente da Comissão de Programa
José Rodrigues Dias

Presidente da Comissão Organizadora
Rui Guimarães



6º Congresso da APDIO

Braga, 28 a 30 de março de 1994
Universidade do Minho

Presidente da Comissão de Programa
Jorge Pinho de Sousa

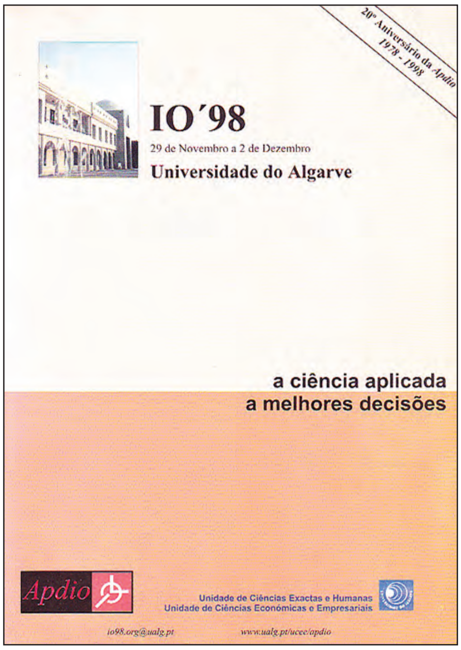
Presidente da Comissão Organizadora
A. Guimarães Rodrigues

7º Congresso da APDIO

Aveiro, 1 a 3 de abril de 1996
Universidade de Aveiro

Presidente da Comissão de Programa
Carlos Bana e Costa

Presidente da Comissão Organizadora
Domingos Moreira Cardoso



8º Congresso da APDIO

Faro, 29 de novembro a 2 de dezembro de 1998
Universidade do Algarve

Presidente da Comissão de Programa
José Pinto Paixão

Presidente da Comissão Organizadora
Fernanda Marília Pires

9º Congresso da APDIO

Setúbal, 16 a 19 de abril de 2000
Instituto Politécnico de Setúbal

Presidente da Comissão de Programa
Carlos Henggeler Antunes

Presidente da Comissão Organizadora
Carlos Luz

10º Congresso da APDIO

Guimarães, 24 a 27 de março de 2002
Universidade do Minho

Presidente da Comissão de Programa
José Fernando Oliveira

Presidente da Comissão Organizadora
José Valério de Carvalho

11º Congresso da APDIO

Porto, 4 a 7 de abril de 2004
Faculdade de Engenharia da Universidade do Porto

Presidente da Comissão de Programa
Joaquim João Júdice

Presidente da Comissão Organizadora
Rui Guimarães

12º Congresso da APDIO

Lisboa, 8 a 11 de outubro de 2006
ISEG - Universidade Técnica de Lisboa

Presidente da Comissão de Programa
Pedro Oliveira

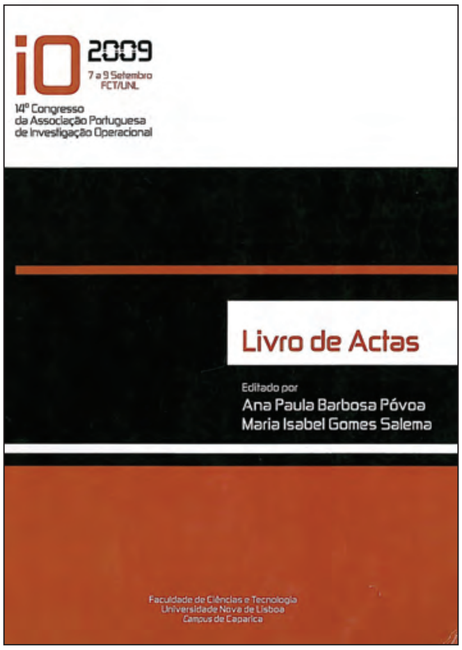
Presidente da Comissão Organizadora
Margarida Vaz Pato

13º Congresso da APDIO

Vila Real, 17 a 19 de março de 2008
Universidade de Trás os Montes e Alto Douro

Presidente da Comissão de Programa
Maria Eugénia Captivo

Presidente da Comissão Organizadora
Ana Paula Teixeira

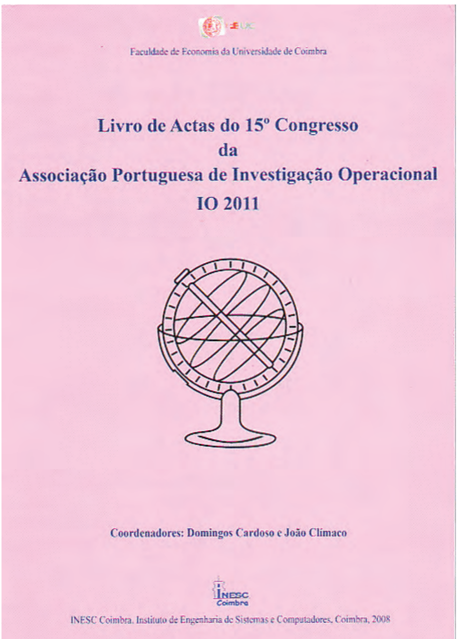


14º Congresso da APDIO

Caparica, 7 a 9 de setembro de 2009
FCT - Universidade Nova de Lisboa

Presidente da Comissão de Programa
Ana Barbosa Póvoa

Presidente da Comissão Organizadora
Ruy Costa



15º Congresso da APDIO

Coimbra, 18 a 20 de abril de 2011
Universidade de Coimbra

Presidente da Comissão de Programa
Domingos Moreira Cardoso

Presidente da Comissão Organizadora
João Clímaco

16º Congresso da APDIO

Bragança, 3 a 5 de junho de 2013
Instituto Politécnico de Bragança

Presidente da Comissão de Programa
José Fernando Oliveira

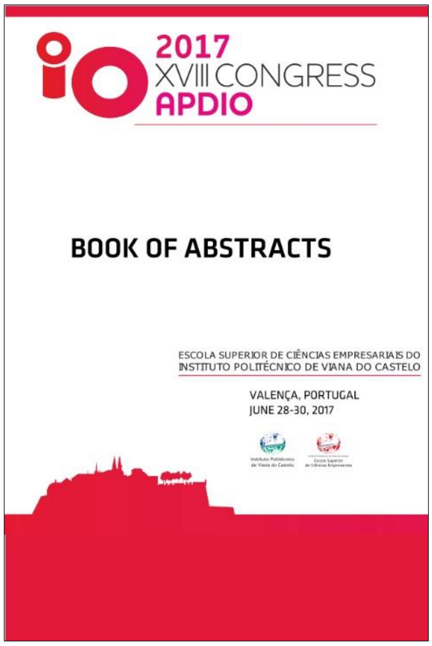
Presidente da Comissão Organizadora
Clara Bento Vaz

17º Congresso da APDIO

Portalegre, 7 a 9 de setembro de 2015
Instituto Politécnico de Portalegre

Presidente da Comissão de Programa
Ana Paula Barbosa-Póvoa

Presidente da Comissão Organizadora
João Luís de Miranda



18º Congresso da APDIO

Valença, 28 a 30 de junho de 2017
Instituto Politécnico de Viana do Castelo

Presidente da Comissão de Programa
António Ismael Freitas Vaz

Presidente da Comissão Organizadora
Lia Oliveira

19º Congresso da APDIO

Aveiro, 5 a 7 de setembro de 2018
Universidade de Aveiro

Presidente da Comissão de Programa
Maria João Alves

Presidentes da Comissão Organizadora
Ana Raquel Xambre
Helena Alvelos

20º Congresso da APDIO

Tomar, 22 a 24 de julho de 2019
Instituto Politécnico de Tomar

Presidente da Comissão de Programa
Susana Relvas

Presidente da Comissão Organizadora
João Patrício

Programa Geral

Time	November 7th
15:00	Hotel check-in & get together
16:00	Welcome drink & poster discussion and voting
17:00	Opening remarks & Plenary session Vice-Almirante Gouveia e Melo
17:45	Coffee break & poster discussion and voting
18:30	Plenary session Sérgio Guedes Silva
19:15	Walking to the dinner
20:00	Cocktail and Conference dinner

Time	November 8th
07:30	Breakfast
08:30	Plenary session Manuel Matos
09:15	Round table 1
10:15	Coffee break & poster discussion
11:00	Round table 2
12:00	Hotel check-out
12:30	Lunch
14:00	Round table 3
15:00	Plenary session Pedro Amorim
15:45	Round table 4
16:45	Coffee break & poster discussion
17:30	Round table 5
18:30	Awards & closing remarks

Sessões Plenárias

Sessão Plenária I

A operação logística da vacinação contra a COVID-19 em Portugal

Vice-Almirante Henrique Gouveia e Melo
Estado-Maior-General das Forças Armadas

Biografia
O Vice-Almirante Henrique Eduardo Passaláqua de Gouveia e Melo nasceu em Quelimane, Moçambique, a 21 de novembro de 1960, e viveu a sua infância e adolescência entre Quelimane, em Moçambique, a cidade de São Paulo, São Paulo, no Brasil e, finalmente, Lisboa, onde chegou aos 18 anos, em setembro de 1979 para ingressar na Escola Naval como Cadete do curso "Carvalho Araújo". Em setembro de 1984, após terminar o curso na Classe de Marinha, com 23 anos, foi promovido a Guarda-Marinha.

Fez o estágio de embarque, de seis meses, na fragata NRP Roberto Ivens, em 1984, antes de assumir as funções de Oficial Imediato do NRP Save, durante um ano, de 1984 a 1985.

Integrou, voluntariamente, a Esquadrilha de Submarinos aos 24 anos, em setembro de 1985, onde navegou nos submarinos NRP Albacora, NRP Barracuda e NRP Delfim, tendo nos primeiros anos e até 1992, exercido diversas funções operacionais como oficial de guarnição e posteriormente como Oficial Imediato nos submarinos NRP Albacora e NRP Barracuda. Durante a sua longa permanência na Esquadrilha de Submarinos que, nesta fase, terminaria em 2002, teve ainda a oportunidade de comandar os submarinos NRP Delfim e NRP Barracuda, chefiar o Serviço de Treino e Avaliação da Esquadrilha de Submarinos e o Estado-Maior da Autoridade Nacional para o Controlo de Operações de Submarinos (SUBOPAUTH).

Após uma passagem de 3 anos como Relações Publicas e Porta-Voz da Marinha, e uma participação decisiva no projeto da nova de classe de submarinos, veio a comandar, entre 2006 e 2008, a fragata NRP Vasco da Gama (F330).

Findo este comando no mar, o Almirante Gouveia e Melo retornou ao meio que encerra a sua grande paixão, a Esquadrilha de Submarinos, novamente como seu Comandante, para liderar o ambicioso projeto de transformação e reconstrução desta estrutura, capacitando-a para a receção e apoio aos novos submarinos. Foi nesta fase, por falecimento do Comandante do submarino NRP Tridente, que voltou a embarcar como responsável pelas provas, testes e operações durante o primeiro ano de vida desta nova unidade, período de garantia após a receção do navio em Portugal. Antes da promoção a Oficial General foi, ainda, 2.º Comandante da Flotilha de Navios, Diretor de Faróis e Diretor do Instituto de Socorros a Náufragos.

Ao longo da sua carreira, frequentou vários cursos, dos quais se destacam a especialização em Comunicações e Guerra Eletrónica, o "International Diesel Electric Submarine Tracking Course"em Norfolk, Virgínia, nos Estados Unidos da América, o Curso Geral Naval de Guerra, uma Pós-Graduação em "Information Warfare"na Universidade Independente, o Curso Complementar Naval de Guerra e finalmente o Curso de Promoção a Oficial General no Instituto de Estudos Superiores Militares.

Após a promoção a Contra-Almirante, em abril de 2014, foi Chefe de Gabinete do Almirante Chefe do Estado-Maior da Armada até novembro de 2016 e, durante um breve período, o 2.º Comandante Naval, exercendo em suplência as funções de Comandante Naval, até janeiro de 2017. Nessa data, com a promoção a Vice-Almirante, passou a exercer as funções de Comandante Naval, período durante o qual exerceu, em acumulação, as funções de Comandante da Força Naval EUROMARFOR, que integra meios portugueses, espanhóis, franceses e italianos.

É, desde janeiro de 2020, o Adjunto para o Planeamento e Coordenação do Estado-Maior General das Forças Armadas, função que, entre 3 de fevereiro e 28 de setembro de 2021, passou a acumular com as de Coordenador da Task Force para combate à COVID-19.

O Vice-Almirante Gouveia e Melo para além dos submarinos e do mar é um apaixonado pelo mundo das Matemáticas, da Física e da Computação.

Ao longo da sua carreira já foi, também, distinguido com diversas condecorações: Comendador (3 de Junho de 2004) e Grã-Cruz (20 de Agosto de 2021) da Ordem Militar de São Bento de Avis,[4] três Medalhas Militares de Ouro de Serviços Distintos, cinco Medalhas Militares de Prata de Serviços Distintos, Medalha de 1.ª Classe de Mérito Militar, Medalha de 2.ª Classe de Mérito Militar, Medalha de 3.ª Classe de Mérito Militar, Medalha de 1.ª Classe da Defesa Nacional, Medalha de 1.ª Classe da Cruz de São Jorge, Medalha de 3.ª Classe da Cruz Naval, Medalha Militar de Ouro de Comportamento Exemplar, Grande-Oficial da Ordem do Mérito Naval do

Brasil, Medalha Mérito Tamandaré do Brasil, Comendador da Ordem do Mérito Marítimo de França, Medalha de Participação na Operação Sharp Guard.

Sessão Plenária II

The power of analytics in a Humanitarian Context

Sérgio Guedes Silva
World Food Program, Roma

Nearly 690 million people regularly go to bed hungry. This means one in eleven people do not have access to enough food, a situation exacerbated further by the ongoing COVID-19 pandemic. One of the key players addressing this issue is the United Nations World Food Programme (WFP), the world's largest humanitarian organization fighting hunger worldwide and winner of the 2020 Nobel Peace Prize. Just last year, WFP assisted 115.5 million people in 84 countries.

Humanitarian operations are complex to manage by nature, as they seek to address multi-faceted problems with limited resources in unstable operational environments. As needs evolve and new information comes in, it is therefore critical to continually monitor and understand each operation, quickly adapt and re-evaluate plans, optimize the use of limited resources, and anticipate what is expected to happen next.

To that end, WFP has been embracing the power of analytics. Engineers and mathematicians have taken a leading role in supporting complex operations, using analytics as an enabler to strengthen the integration between functional areas, augment visibility on WFP operations, and find concrete ways to maximize their efficiency and effectiveness. WFP was awarded in 2020 with the prestigious Franz Edelman Award for Achievement in Advanced Analytics, Operations Research and Management Science.

Biography
Sérgio Guedes Silva leads WFP's Supply Chain Planning service. A graduate in Mechanical Engineering and Management, Sérgio Guedes Silva decided to apply his engineering training to humanitarian causes.

He is leading a team responsible for innovations, operational support and strategic planning. Over the last few years he has been involved in humanitarian crises such as crises in Syria, Ethiopia, Sahel and Mozambique.

He is also the founder and current Council President of G.A.S. Porto, an NGO with around 400 volunteers, and is a regular guest speaker in several events in this field.

Sessão Plenária III

Dealing with uncertainty

Manuel Matos
INESCTEC, Faculdade de Engenharia da Universidade do Porto

Uncertainty affects our decision processes because in an uncertain environment we cannot completely anticipate the impact of our actions. The talk will review and comment some of the approaches used to represent and deal with uncertainty, from arbitrary clairvoyance to the simulation of nature status and of the decisions of others. Fuzzy numbers and intervals will be used to describe uncertain situations and show cases of artificial increase of uncertainty. The interaction of uncertainty with multiple criteria formulations will also be discussed. Illustrative examples will be provided, either general or from the power systems area (easy cases).

Bibiography

Manuel A. Matos was born in 1955 in Porto, Portugal. He is with the Faculty of Engineering of the University of Porto (FEUP), Portugal, since 1978 (Full Professor since 2000).

He is also coordinator of the Centre for Power and Energy Systems of INESC TEC and President of the Scientific Council of INESC TEC.

His research interests include classical and fuzzy modeling of power systems, reliability, planning, optimization and decision-aid, with application to renewable energy sources integration, electric vehicles' deployment and smart grids.

Sessão Plenária IV

How can we lift the practical relevance of our research in operations research?

Pedro Amorim
INESCTEC, Faculdade de Engenharia da Universidade do Porto

This presentation aims to discuss opportunities for our community to increase the practical relevance of its research. We'll start by discussing why practical research relevance matters for Operations Research. These opportunities will be discussed using a framework of suggestions, such as developing a practitioner advisory team or writing for practitioners in different mediums. We conclude by analyzing ways in which academic institutions can help in the persecution of this goal.

Biography

Pedro Amorim is an Assistant Professor (with habilitation) at Industrial Engineering and Management Department at FEUP and also an invited professor at Porto Business School. Since 2016, he's the Head of Research Center for Industrial Engineering and Management from INESC Technology and Science. He is also a co-founder of LTPlabs.

He was a visiting scholar IESE Business School (Spain) and at Carnegie Mellon University (USA) and he was a visiting researcher at Technical University of Berlin, Ingolstadt School of Management, University of São Paulo and Technical University of Lisbon. He leads a European Group focused on Retail.

In this domain he has conducted several projects applying advanced analytics to decision-making. He is also the author of more than 50 research papers published in international journals on Supply Chain Management, Retail Operations, and Optimization.

He holds a MSc and a PhD degree of Industrial Engineering and Management, from University of Porto, Portugal.

Resumos e Posters

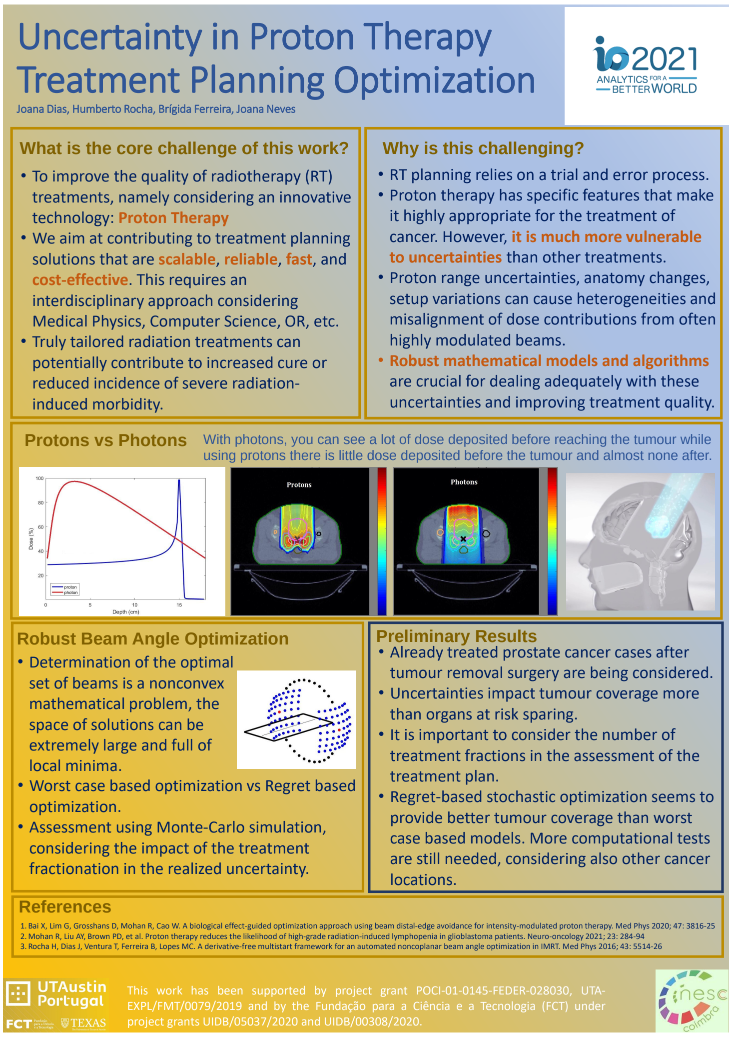
Submissão #3

Uncertainty in Proton Therapy Treatment Planning Optimization

Joana Dias, Humberto Rocha, Brígida Ferreira, Joana Neves

Radiotherapy treatment planning (RTP) is a research area where Operational Research and Medical Physics are a match made in heaven, with Operational Research being crucial for the improvement of treatment quality. RTP can be seen as a multiobjective optimization problem under uncertainty. In proton treatment, one of the most recent treatment modalities, tackling uncertainty in an explicit way is even more important than in other modalities. Proton beams have unique depth-dose characteristics. Protons slow down as they penetrate matter, their rate of energy transfer increases with depth, coming to an abrupt stop just beyond where energy deposition is maximum producing the so-called Bragg peak. By positioning several Bragg peaks inside the target volume, excellent tumor coverage is obtained, and adjacent organs at risk are spared. However, proton treatment is much more vulnerable to uncertainties due to high dose gradients. Continuing the conventional practice of defining safety margins around the tumour is not appropriate and robust optimization of treatment plans is necessary. In this work, different robust optimization approaches will be presented and compared, namely comparing absolute-robust models, where the objective is to look at the worst case scenario, with relative-robust approaches that consider the concept of regret.

Keywords: Radiotherapy Treatment Optimization, Optimization under Uncertainty, Robust Optimization



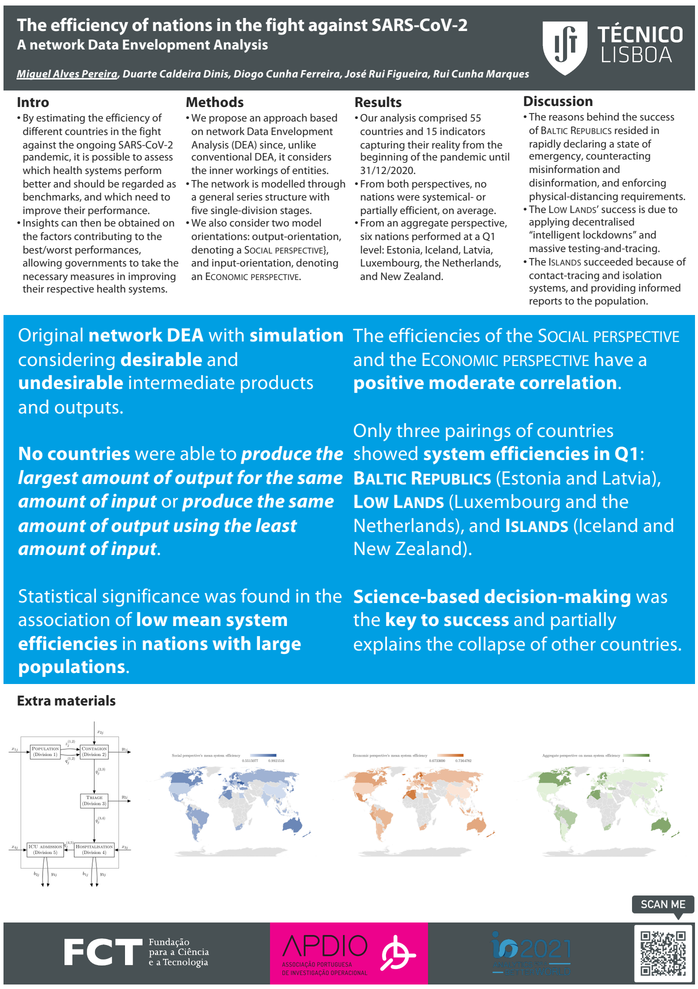
Submissão #4

The efficiency of nations in the fight against SARS-CoV-2: A network Data Envelopment Analysis

Miguel Pereira, Duarte Dinis, Diogo Ferreira, José Rui Figueira, Rui Marques

The current outbreak of SARS-CoV-2 has been having a major impact on health systems worldwide. Therefore, there is a need to understand the efficiency of the pandemic response across several nations and derive insights that can help governments and health authorities improve their national COVID-19 strategies. Thus, we conducted a network Data Envelopment Analysis (DEA) to estimate the efficiencies of fifty-five countries in the current crisis, designing the model as a general series structure with five single-division stages (population, contagion, triage, hospitalisation, and intensive care unit admission) and considering an output-maximisation orientation - to denote a social perspective - and an input-minimisation orientation - to denote an economic perspective. Our proposal considers inputs regarding health costs, desirable and undesirable intermediate products regarding the use of personal protective equipment and infected population, respectively, and desirable and undesirable outputs regarding COVID-19 recoveries and deaths, respectively. The study concludes that Estonia, Iceland, Latvia, Luxembourg, the Netherlands, and New Zealand are the countries that exhibit higher mean system efficiencies - their national COVID-19 strategies should be studied, adapted, and used by the countries that exhibit worse performances. Furthermore, we found statistical significance in the fact that countries with large populations present worse mean efficiency scores.

Keywords: Data Envelopment Analysis, Simulation, Series structure, SARS-CoV-2, Efficiency measurement



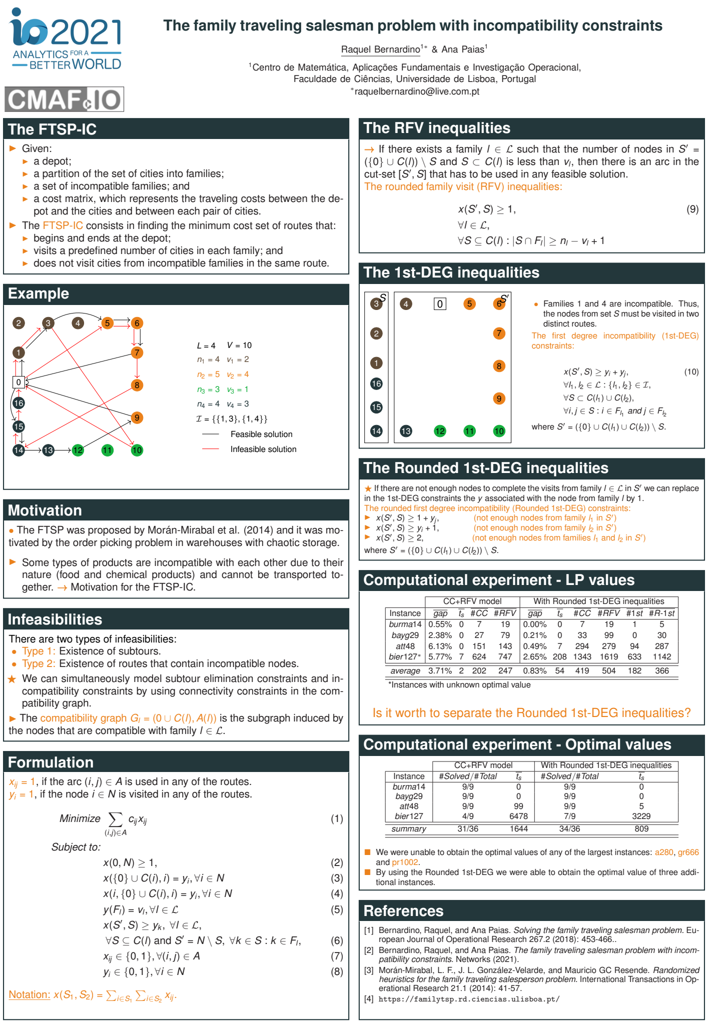
Submissão #5

The family traveling salesman problem with incompatibility constraints

Raquel Bernardino, Ana Paias

Consider a depot and a partition of the set of nodes into subsets, called families. The objective of the family traveling salesman problem (FTSP) is to find the minimum cost route that starts and ends at the depot and visits a given number of nodes per family. We propose a new variant of the FTSP by introducing incompatibilities between the families, that is, incompatible families cannot be visited in the same route. Thus, the FTSP with incompatibility constraints (FTSP-IC) consists of determining the minimum cost set of routes that begins and ends at the depot; visits a given number of cities in each family; and does not visit incompatible nodes in the same route. We propose compact and non-compact formulations for the FTSP-IC, which model the incompatibility constraints for each family implicitly in compatibility graphs. We also present a new set of valid inequalities. To evaluate the different models, we used the benchmark instances for the FTSP and generated incompatibility matrices. The computational experiment shows that the non-compact models outperform the compact ones. We developed an iterated local search, which efficiently obtains solutions with a lower value than the branch-and-cut algorithm for the largest instances, with an unknown optimal value.

Keywords: Family traveling salesman problem, Branch-and-cut algorithm, Incompatibility constraints, Iterated local search algorithm



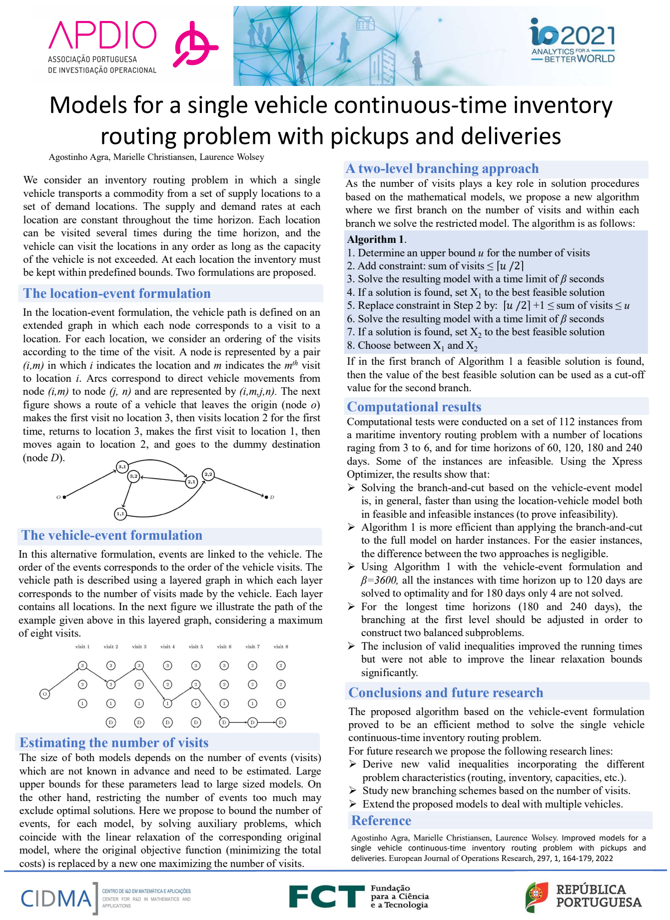
Submissão #6

Models for a single vehicle continuous-time inventory routing problem with pickups and deliveries

Agostinho Agra, Marielle Christiansen, Laurence Wolsey

An inventory routing problem in which a single vehicle is responsible for the transport of a commodity from a set of supply locations to a set of demand locations is considered. At each location the inventory must be kept within predefined bounds, and the location specific supply and demand rates are constant throughout the time horizon. Each location can be visited several times during the time horizon, and the vehicle can visit the locations in any order as long as the capacity of the vehicle is not exceeded. Two models are presented, each defined on a different extended network. In a location-event model, the nodes are indexed by the location and the number of visits made so far to that location, while in a vehicle-event model the nodes are indexed by the location and the number of visits so far on the vehicle route. Both models are based on continuous time formulations. Bounds on the number of vehicle visits are discussed and a new branching algorithm is proposed. Computational tests based on a set of maritime transportation instances are reported to compare both models and test the new branching algorithm.

Keywords: Inventory, Routing, Strong formulations, Branching



Submissão #7

Defining hospital networks with centralized waiting lists for elective patients

Mariana Oliveira, Daniel Santos

Long waiting lists for elective surgery can be a consequence of the inability of hospitals to provide timely care, which may happen due to lack of physical or human resources or due to inefficiencies in the management of elective patients. This research work aims to identify the main sources of problems in the strategic planning of operating rooms, particularly on waiting list management. For this purpose, an optimization model to support decisions about waiting list pooling agreements among hospitals is proposed. This model allows to compare the performance of individual hospitals when waiting lists are centralized at different levels. The network system perspective grants the opportunity to reduce costs and increase compliance with each individual hospital's strategic missions, as waiting time targets are considered and, consequently, improved quality of care is pursued.

Keywords: Health services, Strategic decisions, Optimization

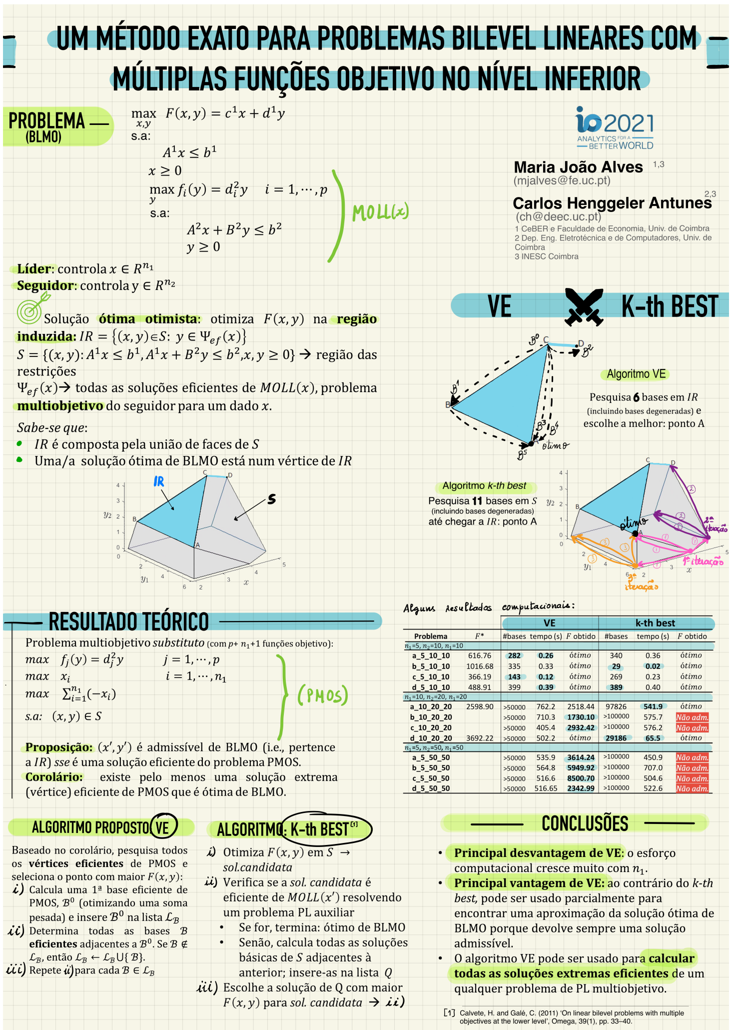
Submissão #8

Um método exato para problemas bilevel lineares com múltiplas funções objetivo no nível inferior

Maria João Alves, Carlos Henggeler Antunes

Neste trabalho consideramos problemas de otimização em dois níveis (bilevel) lineares com múltiplas funções objetivo no nível inferior. Propomos um método exato para calcular a solução ótima da formulação otimista do problema, que se baseia na transformação do problema original num problema de programação linear multiobjetivo (PLMO) equivalente. A solução ótima é obtida através da pesquisa de soluções eficientes extremas do problema de PLMO. Para o efeito, foi desenvolvido um algoritmo que calcula todas as bases eficientes deste problema equivalente. Como o problema de PLMO pode ter um número elevado de funções objetivo, o qual depende do número de variáveis de nível superior do problema bilevel, o esforço computacional para obter a solução ótima pode ser significativo. No entanto, este método tem a vantagem de fornecer sempre uma solução admissível do problema bilevel quando é considerada uma limitação do tempo computacional que não permite terminar a respetiva execução, o que não acontece em outros métodos da literatura. é apresentada uma comparação entre este novo método e outro algoritmo exato de referência proposto por outros autores, enfatizando as vantagens e desvantagens de cada um dos métodos.

Palavras chave: Programação multiobjetivo, Otimização bilevel, Método simplex multiobjetivo



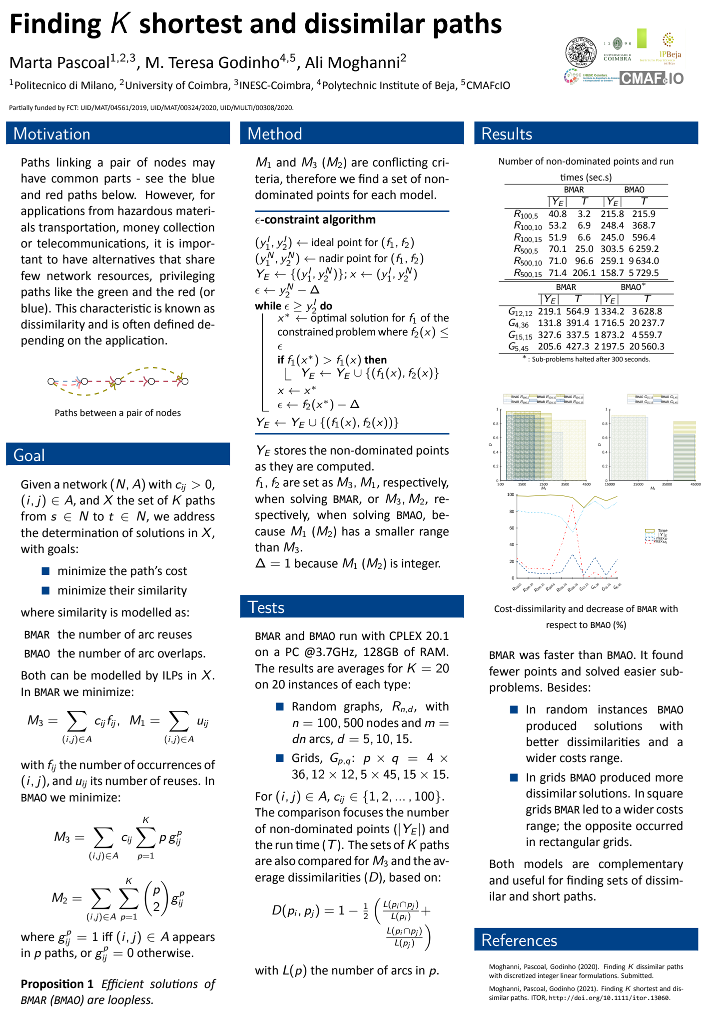
Submissão #9

The determination of sets of short and dissimilar paths

Marta Pascoal, Maria Teresa Godinho, Ali Moghanni

We address the problem of finding sets of K paths, with K a given integer, that simultaneously consider two criteria: the minimization of the total cost of the paths and the maximization of the dissimilarity between them. The purpose of these objectives is to find low cost/distance/time solutions, but which are also fairly different from one another, which are relevant considerations in applications that range from hazardous materials transportation to cash collection. Two approaches are used to measure the dissimilarity of a set of paths: the extent of the overlap of the paths, in terms of the number of times that each arc appears in more than one of them; and the number of times that the arcs shared by two or more paths appear in that solution. The bi-objective problems resulting from each of these approaches are modeled in terms of integer linear programs, and ε-constraint methods are then designed to solve them. Finally, computational experiments compare the results obtained by the two approaches in terms of the efficiency regarding computational time and of the dissimilarity of the efficient solutions for each problem.

Keywords: K alternative paths, Cost, Dissimilarity, IP formulations, Bi-objective optimization



Finding K shortest and dissimilar paths

Marta Pascoal[1,2,3], M. Teresa Godinho[4,5], Ali Moghanni[2]

[1]Politecnico di Milano, [2]University of Coimbra, [3]INESC-Coimbra, [4]Polytechnic Institute of Beja, [5]CMAFcIO

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Motivation

Paths linking a pair of nodes may have common parts - see the blue and red paths below. However, for applications from hazardous materials transportation, money collection or telecommunications, it is important to have alternatives that share few network resources, privileging paths like the green and the red (or blue). This characteristic is known as dissimilarity and is often defined depending on the application.

Paths between a pair of nodes

Goal

Given a network (N, A) with $c_{ij} > 0$, $(i, j) \in A$, and X the set of K paths from $s \in N$ to $t \in N$, we address the determination of solutions in X, with goals:

- minimize the path's cost
- minimize their similarity

where similarity is modelled as:

BMAR the number of arc reuses
BMAO the number of arc overlaps.

Both can be modelled by ILPs in X. In BMAR we minimize:

$$M_3 = \sum_{(i,j)\in A} c_{ij} f_{ij}, \quad M_1 = \sum_{(i,j)\in A} u_{ij}$$

with f_{ij} the number of occurrences of (i, j), and u_{ij} its number of reuses. In BMAO we minimize:

$$M_3 = \sum_{(i,j)\in A} c_{ij} \sum_{p=1}^{K} p\, g_{ij}^p$$

$$M_2 = \sum_{(i,j)\in A} \sum_{p=1}^{K} \binom{p}{2} g_{ij}^p$$

where $g_{ij}^p = 1$ iff $(i, j) \in A$ appears in p paths, or $g_{ij}^p = 0$ otherwise.

Proposition 1 *Efficient solutions of BMAR (BMAO) are loopless.*

Method

M_1 and M_3 (M_2) are conflicting criteria, therefore we find a set of non-dominated points for each model.

ϵ-constraint algorithm

$(y_1^I, y_2^I) \leftarrow$ ideal point for (f_1, f_2)
$(y_1^N, y_2^N) \leftarrow$ nadir point for (f_1, f_2)
$Y_E \leftarrow \{(y_1^I, y_2^N)\}$; $x \leftarrow (y_1^I, y_2^N)$
$\epsilon \leftarrow y_2^N - \Delta$
while $\epsilon \geq y_2^I$ **do**
  $x^* \leftarrow$ optimal solution for f_1 of the constrained problem where $f_2(x) \leq \epsilon$
  if $f_1(x^*) > f_1(x)$ **then**
    $Y_E \leftarrow Y_E \cup \{(f_1(x), f_2(x)\}$
  $x \leftarrow x^*$
  $\epsilon \leftarrow f_2(x^*) - \Delta$
$Y_E \leftarrow Y_E \cup \{(f_1(x), f_2(x))\}$

Y_E stores the non-dominated points as they are computed.
f_1, f_2 are set as M_3, M_1, respectively, when solving BMAR, or M_3, M_2, respectively, when solving BMAO, because M_1 (M_2) has a smaller range than M_3.
$\Delta = 1$ because M_1 (M_2) is integer.

Tests

BMAR and BMAO run with CPLEX 20.1 on a PC @3.7GHz, 128GB of RAM. The results are averages for $K = 20$ on 20 instances of each type:

- Random graphs, $R_{n,d}$, with $n = 100, 500$ nodes and $m = dn$ arcs, $d = 5, 10, 15$.
- Grids, $G_{p,q}$: $p \times q = 4 \times 36, 12 \times 12, 5 \times 45, 15 \times 15$.

For $(i, j) \in A$, $c_{ij} \in \{1, 2, \ldots, 100\}$. The comparison focuses the number of non-dominated points ($|Y_E|$) and the run time (T). The sets of K paths are also compared for M_3 and the average dissimilarities (D), based on:

$$D(p_i, p_j) = 1 - \frac{1}{2}\left(\frac{L(p_i \cap p_j)}{L(p_i)} + \frac{L(p_i \cap p_j)}{L(p_j)}\right)$$

with $L(p)$ the number of arcs in p.

Results

Number of non-dominated points and run times (sec.s)

	BMAR		BMAO	
	$\lvert Y_E\rvert$	T	$\lvert Y_E\rvert$	T
$R_{100,5}$	40.8	3.2	215.8	215.9
$R_{100,10}$	53.2	6.9	248.4	368.7
$R_{100,15}$	51.9	6.6	245.0	596.4
$R_{500,5}$	70.1	25.0	303.5	6 259.2
$R_{500,10}$	71.0	96.6	259.1	9 634.0
$R_{500,15}$	71.4	206.1	158.7	5 729.5

	BMAR		BMAO*	
	$\lvert Y_E\rvert$	T	$\lvert Y_E\rvert$	T
$G_{12,12}$	219.1	564.9	1 334.2	3 628.8
$G_{4,36}$	131.8	391.4	1 716.5	20 237.7
$G_{15,15}$	327.6	337.5	1 873.2	4 559.7
$G_{5,45}$	205.6	427.3	2 197.5	20 560.3

*: Sub-problems halted after 300 seconds.

Cost-dissimilarity and decrease of BMAR with respect to BMAO (%)

BMAR was faster than BMAO. It found fewer points and solved easier sub-problems. Besides:

- In random instances BMAO produced solutions with better dissimilarities and a wider costs range.
- In grids BMAO produced more dissimilar solutions. In square grids BMAR led to a wider costs range; the opposite occurred in rectangular grids.

Both models are complementary and useful for finding sets of dissimilar and short paths.

References

Moghanni, Pascoal, Godinho (2020). Finding K dissimilar paths with discretized integer linear formulations. Submitted.

Moghanni, Pascoal, Godinho (2021). Finding K shortest and dissimilar paths. ITOR, http://doi.org/10.1111/itor.13060.

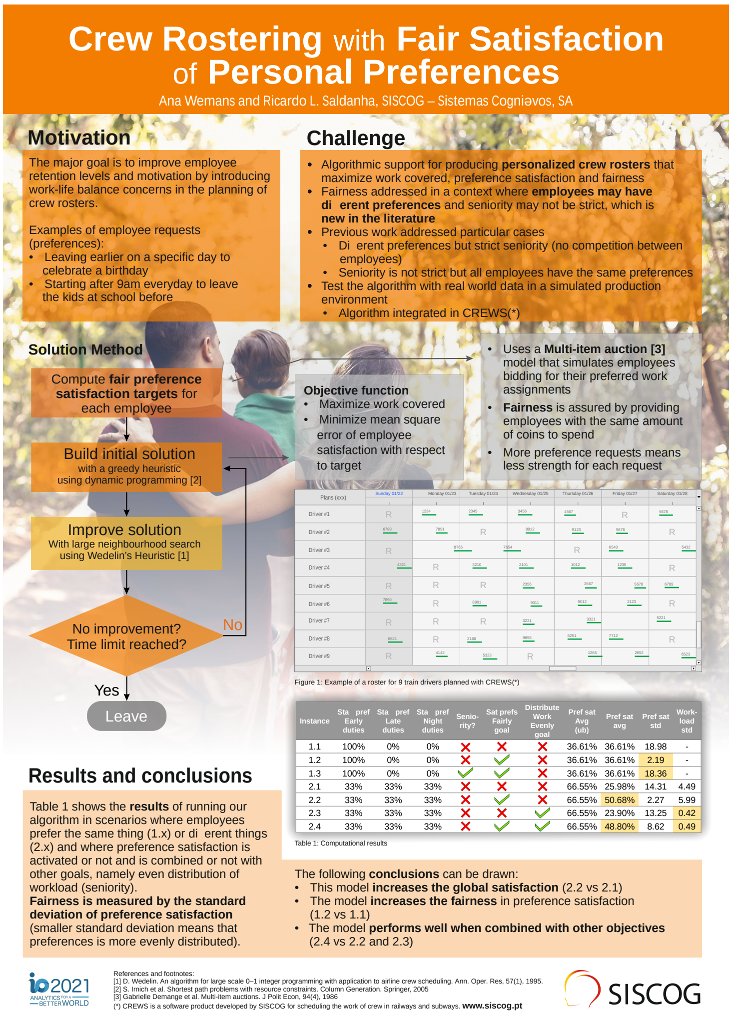
Submissão #10

Crew rostering with fair satisfaction of personal preferences

Ana Wemans, Ricardo L. Saldanha

We address the personalised crew rostering problem in a context where each employee has its own skills, seniority and preferences and where optimisation goals include covering as much work as possible, maximise preference satisfaction and fairness. Previous work addressed only two extreme particular cases: the case where fairness means equal distribution of preference satisfaction, which is only valid in contexts where all employees prefer the same thing, or the case where fairness means uneven distribution but according to strict seniority, which is a context where employees don't really compete among themselves for the same work assignments. We propose an approach based on large neighbourhood search, dynamic programming, integer programming and a multi-item auction model for addressing a more generic case where employees may prefer different things and where seniority may not be strict. We evaluate the approach with real world data.

Keywords: Personalised crew rostering, Fairness, Crew preferences



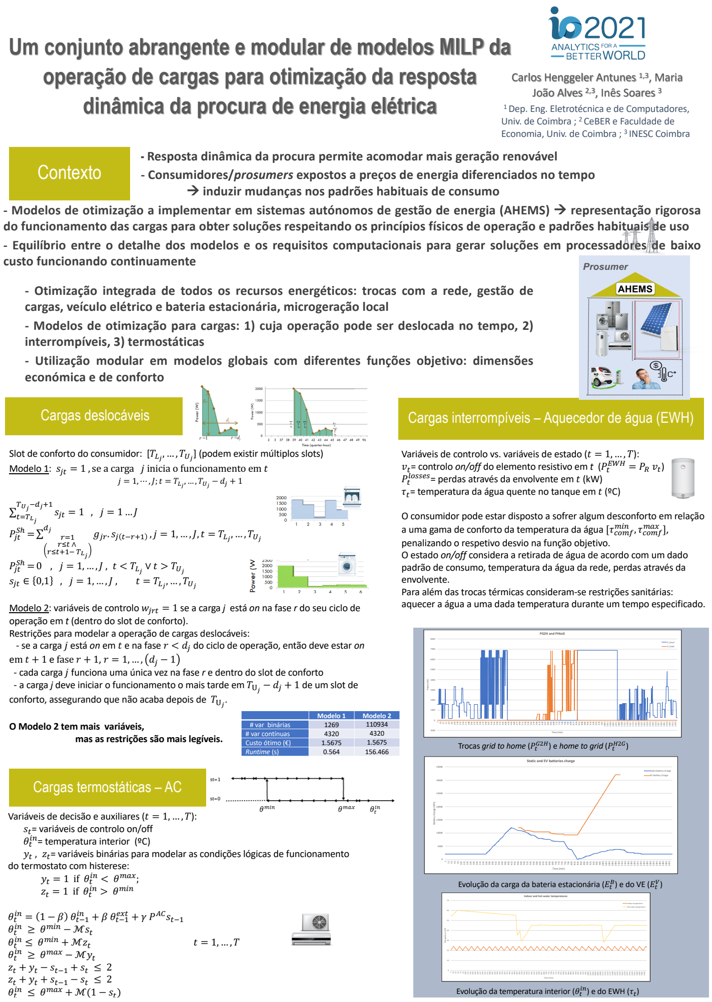
Submissão #11

Um conjunto abrangente e modular de modelos MILP da operação de cargas para otimização da resposta dinâmica da procura de energia elétrica

Carlos Henggeler Antunes, Maria João Alves, Inês Soares

A resposta dinâmica da procura permite acomodar maior quantidade de geração de energia elétrica de origem renovável, por sua vez essencial para descarbonizar a economia e mitigar o aquecimento global. Os consumidores/prosumers estarão cada vez mais expostos a preços de energia diferenciados no tempo, destinados a induzir mudanças nos padrões habituais de consumo. Os modelos de otimização a implementar em sistemas autónomos de gestão de energia requerem uma representação rigorosa do funcionamento das cargas para obter soluções respeitando os seus princípios físicos de operação e padrões habituais de uso. Neste contexto, é necessário um equilíbrio entre o detalhe dos modelos e os requisitos computacionais para gerar soluções em processadores de baixo custo. Esta comunicação apresenta um conjunto abrangente e modular de modelos de programação linear inteira mista, permitindo a sua incorporação em sistemas de gestão de energia para a otimização integrada de todos os recursos energéticos (trocas com a rede, gestão de cargas, veículo elétrico e bateria estacionária , microgeração local). São apresentados modelos de otimização para cargas cuja operação pode ser deslocada no tempo, interruptíveis e termostáticas. Estes modelos podem ser utilizados de forma modular em modelos globais com diferentes funções objetivo considerando as dimensões económica e de conforto.

Palavras chave: Resposta dinâmica da procura, Modelação de cargas, Programação linear inteira mista



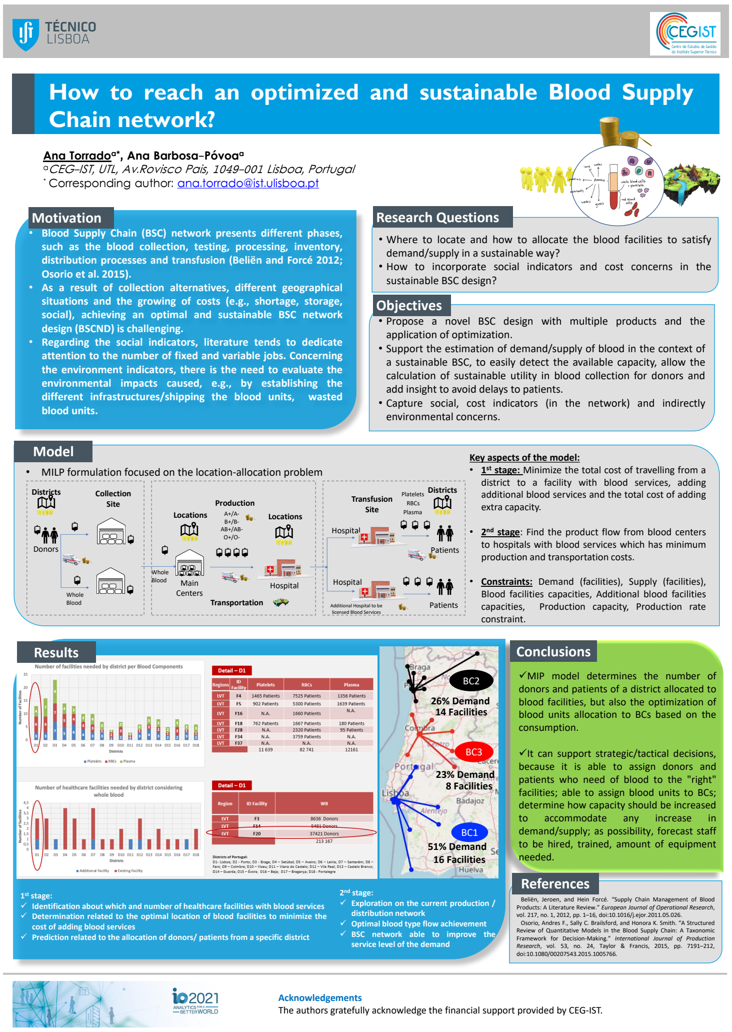
Submissão #12

How to reach an optimized and sustainable Blood Supply Chain network?

Ana Torrado, Ana Barbosa-Póvoa

Blood has a prominent role in human life. However, blood is scarce, perishable and not replaceable. Blood donation system must deliver enough supply of blood to the hospitals. An effective collection of blood from donors and a suitable blood production is vital to satisfy the Blood Supply Chain (BSC), to optimize a fair blood usage and, consequently, to reduce shortages, outdates and wastage. In this work we develop a location-allocation model for the design of a sustainable and strategic-tactical BSC. We aim a balancing production of the different blood types, considering the social and the costs dimensions. The model incorporates the blood donor's allocation to the different facilities; the patient's allocation (while receiving RBCs, PLTs, PLS) to the healthcare facilities and the remaining capacity for satisfying demand and supply. Data available in the NHS of Portugal illustrates the applicability of the proposed model, serving as a validation tool.

Keywords: BSC, Sustainability, Location-Allocation, MILP, Optimization



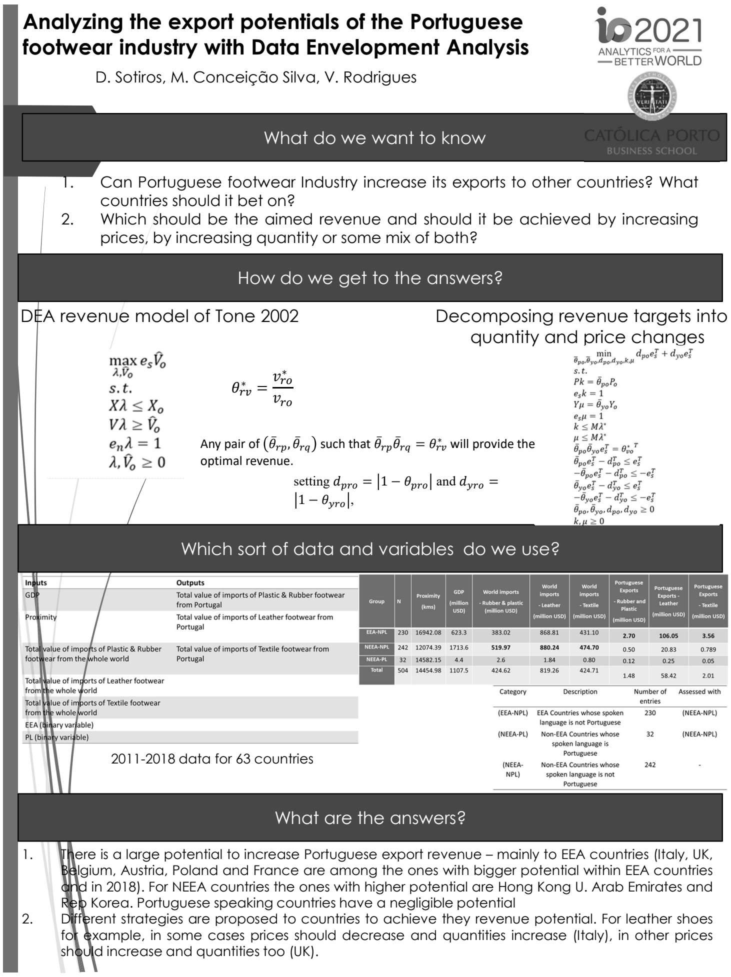
Submissão #13

Analysing the export potentials of the Portuguese footwear industry by Data Envelopment Analysis

Dimitrios Sotiros, Maria Silva, Vasco Rodrigues

Exports are widely believed to play a central role in economic development and firms' profitability, particularly in countries with small domestic markets. With that aim, governments and firms spend considerable resources on international promotion. Identifying the markets with the greatest potential for export growth is therefore crucial for an efficient allocation of public and private resources. In this paper, we propose a Data Envelopment Analysis framework to identify trading potentials with existing trading partner countries within an industry. To illustrate its applicability, we use data from the Portuguese footwear industry. Specifically, among the countries that currently import Portuguese footwear, we aim to identify those that have the greatest potential for increasing their imports from Portuguese footwear in terms of revenue. We further decompose this potential into price and quantity changes to provide strategic directions to the Portuguese footwear industry. For the analysis, we use panel data of 64 countries analyzed over the years 2011-2018. The results reveal that higher potentials lie among the countries of the European Economic Area. Overall, these potentials may be achieved through different price-quantity strategies.

Keywords: Trading and exports, Data Envelopment analysis, Export performance



Submissão #14

Limites aos custos num modelo de Joint Replenishment Problem com itens sujeitos a obsolescência

Ricardo Afonso, Pedro Godinho, João Paulo Costa

Uma família de diferentes tipos de itens a encomendar pode ser constituída, entre outras razões, por os itens terem um fornecedor comum, serem entregues no mesmo meio de transporte ou serem produzidos na mesma unidade fabril. O Joint Replenishment Problem (JRP) debruça-se sobre a problemática de coordenação de encomendas com o objetivo de minimizar o custo total, composto por custos de encomendar e custos de posse, garantindo a satisfação da procura. A complexidade deste problema aumenta quando os itens estão sujeitos a processos de obsolescência. Isto decorre do facto de os itens poderem sofrer uma queda abrupta da procura por deixarem de ser necessários, devido ao rápido avanço da tecnologia, ficarem fora de moda, ou deixarem de ser economicamente viáveis, por exemplo. A presente comunicação considera uma extensão do JRP onde os itens podem repentinamente tornar-se obsoletos. A procura é assumida como constante e os tempos de vida dos itens seguem distribuições exponenciais negativas. Pretende-se, assim, otimizar o custo total atualizado esperado. Além da apresentação do modelo, abordam-se ainda algumas propriedades que podem conduzir ao desenvolvimento de aproximações para a obtenção de soluções de forma mais eficiente, tais como a definição de limites inferiores e superiores ao custo total.

Palavras chave: Gestão de stocks, Joint Replenishment Problem, Obsolescência

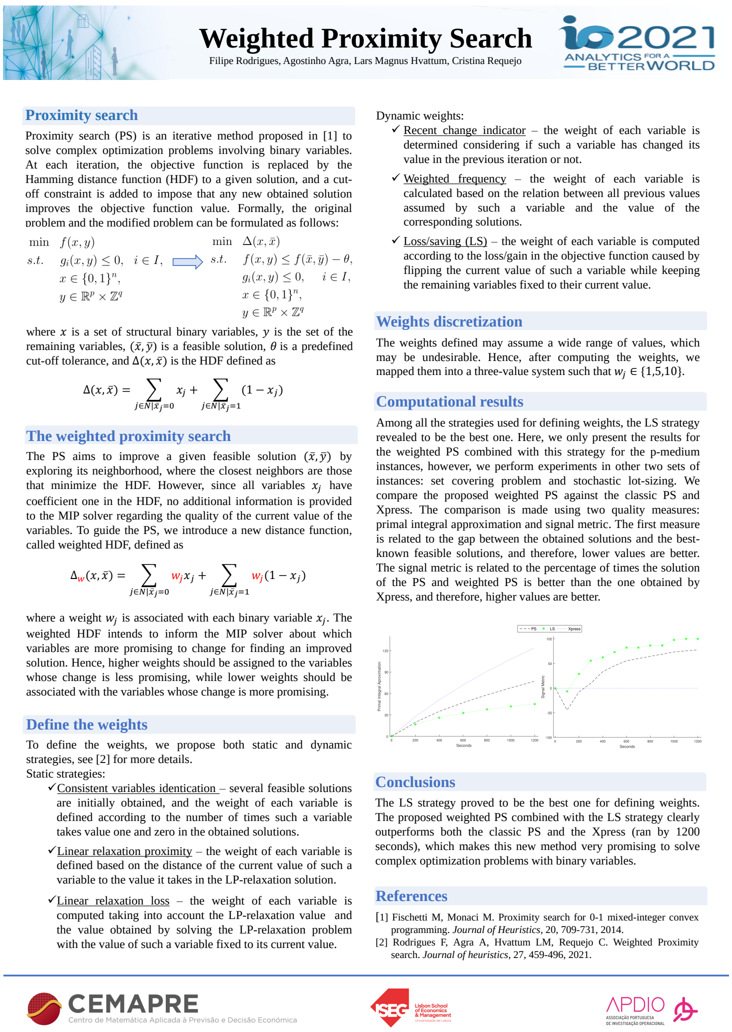
Submissão #15

Weighted proximity search

Filipe Rodrigues, Agostinho Agra, Lars Magnus Hvattum, Cristina Requejo

Proximity search is an iterative method to solve complex mathematical programming problems. At each iteration, the objective function of the problem at hand is replaced by the Hamming distance function to a given solution, and a cutoff constraint is added to impose that any new obtained solution improves the objective function value. A mixed integer programming solver is used to find a feasible solution to this modified problem, yielding an improved solution to the original problem. We introduce the concept of weighted Hamming distance that allows to design a new method called weighted proximity search. In this new distance function, low weights are associated with the variables whose value in the current solution is promising to change in order to find an improved solution, while high weights are assigned to variables that are expected to remain unchanged. The weights help to distinguish between alternative solutions in the neighborhood of the current solution, and provide guidance to the solver when trying to locate an improved solution. Several strategies to determine weights are presented. The proposed weighted proximity search is compared with the classic proximity search on instances from three optimization problems leading to very promising results.

Keywords: Mixed integer programming, Matheuristic, Local search



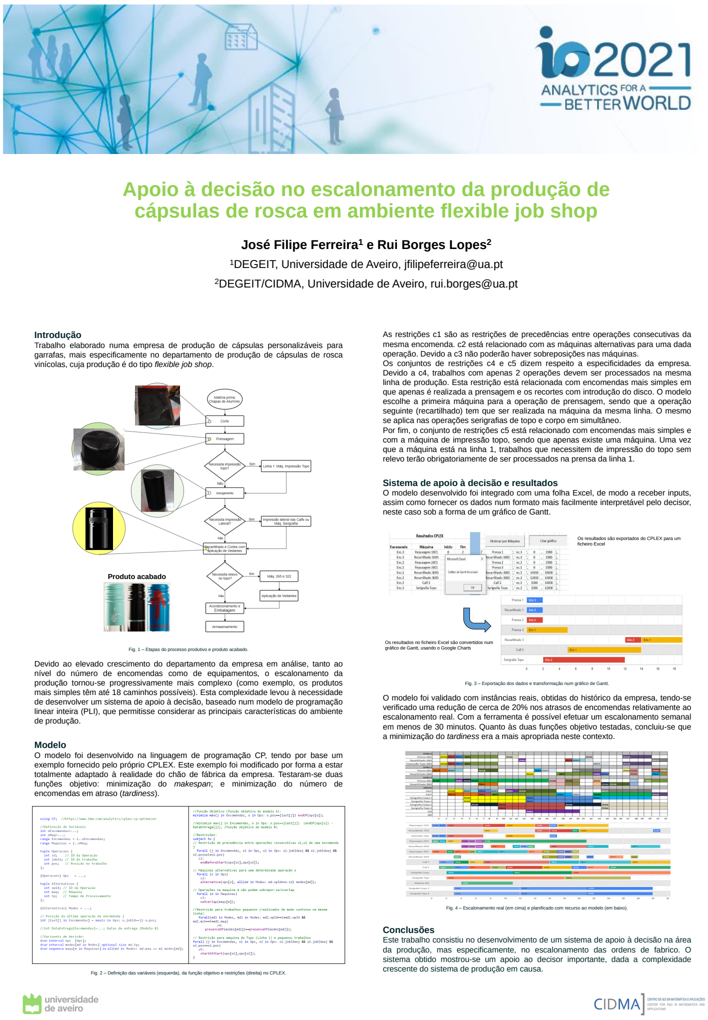
Submissão #16

Apoio à decisão no escalonamento da produção de cápsulas de rosca em ambiente flexible job shop

José Filipe Ferreira, Rui Borges Lopes

Este trabalho foi elaborado numa empresa de produção de cápsulas personalizáveis para garrafas, mais especificamente no departamento de produção de cápsulas de rosca vinícolas, cuja produção é do tipo flexible job shop. Devido ao elevado crescimento do departamento da empresa em análise, tanto ao nível do número de encomendas como de equipamentos, o escalonamento da produção tornou-se progressivamente mais complexo. Esta complexidade levou à necessidade de desenvolver um sistema de apoio à decisão, baseado num modelo de programação linear inteira (PLI), que permitisse considerar as principais características do ambiente de produção. O modelo desenvolvido foi implementado em CPLEX, tendo sido testadas duas funções objetivo distintas: minimização do makespan e minimização do número de encomendas em atraso. Este modelo foi integrado com uma folha de Excel, a modo de receber inputs, assim como fornecer os dados num formato mais facilmente interpretável pelo decisor, neste caso sob a forma de um gráfico de Gantt. O modelo foi validado com instâncias reais, obtidas do histórico da empresa, tendo-se verificado uma redução de cerca de 20% nos atrasos de encomendas relativamente ao escalonamento efetuado.

Palavras chave: Sistema de apoio à decisão, Escalonamento, Flexible Job Shop Problem



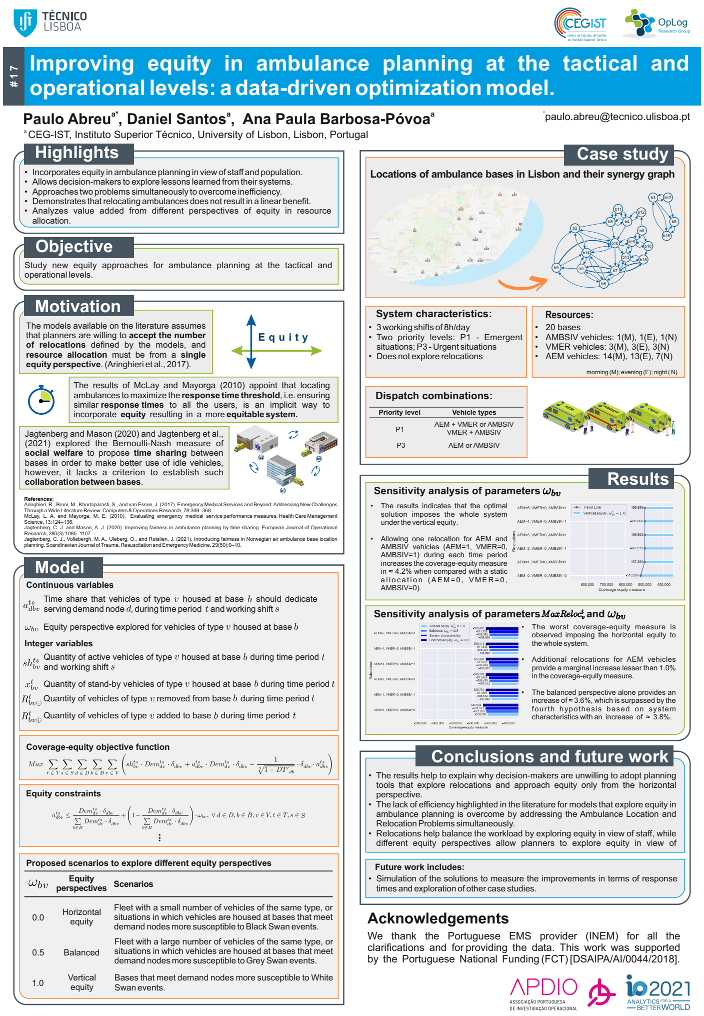
Submissão #17

Melhoria da equidade no planeamento de ambulâncias a nível tático e operacional: um modelo de otimização orientado por dados.

Paulo Abreu, Daniel Santos, Ana Barbosa-Póvoa

O planeamento de ambulâncias envolve um conjunto de problemas de planeamento interrelacionados abordados a nível tático e operacional de forma independente, onde se incluem problemas de localização e de realocação das ambulâncias. Estudos recentes têm estudado a incorporação de equidade no primeiro problema onde as decisões são tomadas num horizonte de planeamento de médio prazo; contudo, estes estudos demonstram a existência de um desequilíbrio em termos de equidade e eficiência. Por outro lado, o segundo trata de decisões que são tomadas a curto prazo e centra-se na atualização da correspondência entre a oferta e a procura. Reconhecendo as características dos problemas e o facto da equidade ser um objetivo emergente a ser alcançado, propõe-se um novo modelo dinâmico de otimização para lidar com ambos os problemas em simultâneo, visando ultrapassar a questão da ineficiência. Para além do novo modelo, propõe-se uma abordagem que explora a equidade a partir de diferentes perspetivas, nomeadamente vertical e horizontal. Resultados computacionais mostram que tal abordagem contribui para melhorar a equidade de ambos os lados, pessoal e população, e demonstra que as realocações resultam num benefício que não é linear, explicando a resistência dos decisores em executá-las na prática.

Palavras chave: Serviços de Emergência Médica, Equidade, Problema de Localização das Ambulâncias, Problema de Realocação das Ambulâncias, Programação Linear Inteira Mista



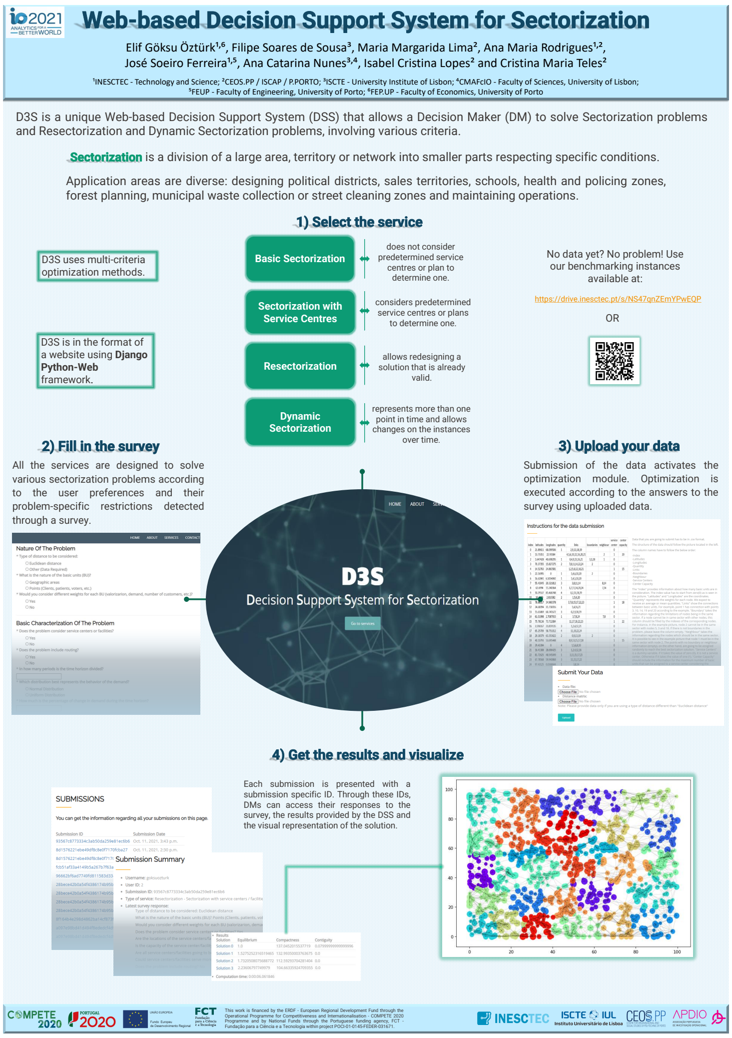
Submissão #18

Web-based Decision Support System for Sectorization

Elif Goksu Ozturk, Filipe S. de Sousa, Maria Margarida Lima, Ana Maria Rodrigues, José Soeiro Ferreira, Ana Catarina Nunes, Cristina Lopes, Cristina Teles

A Decision Support System (DSS) is an information system that provides computer help to decision-makers (DMs) to solve their specific problems. Under the project 'Sectorization to Simplify and Solve (StoSS)', we present a DSS to solve sectorization problems. Sectorization is the division of a large area, territory or network into smaller parts considering one or more objectives. The purpose of sectorization is usually to increase the efficiency and effectiveness of problem-solving. The application areas are diverse and often arise related to geographical issues. Examples include designing political districts, sales territories, school or health districting and policing zones, forest planning, waste collection or street cleaning zones and maintenance operations. Given this diversity in terms of applications, solution procedures are challenging. We design the DSS to provide solutions for various sectorization problems in a website format with a user-friendly outline. We clustered the sectorization problems into four main groups: (i) basic sectorization problems, (ii) sectorization problems with service centres, (iii) re-sectorization problems, and (iv) dynamic sectorization problems. All these groups allow the user to shape and solve the specific problem for their case. This work is financed by the ERDF - European Regional Development Fund through the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020 Programme and by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia within project POCI-01-0145-FEDER-031671.

Keywords: Sectorization, Resectorization, Decision Support System, Decision Making



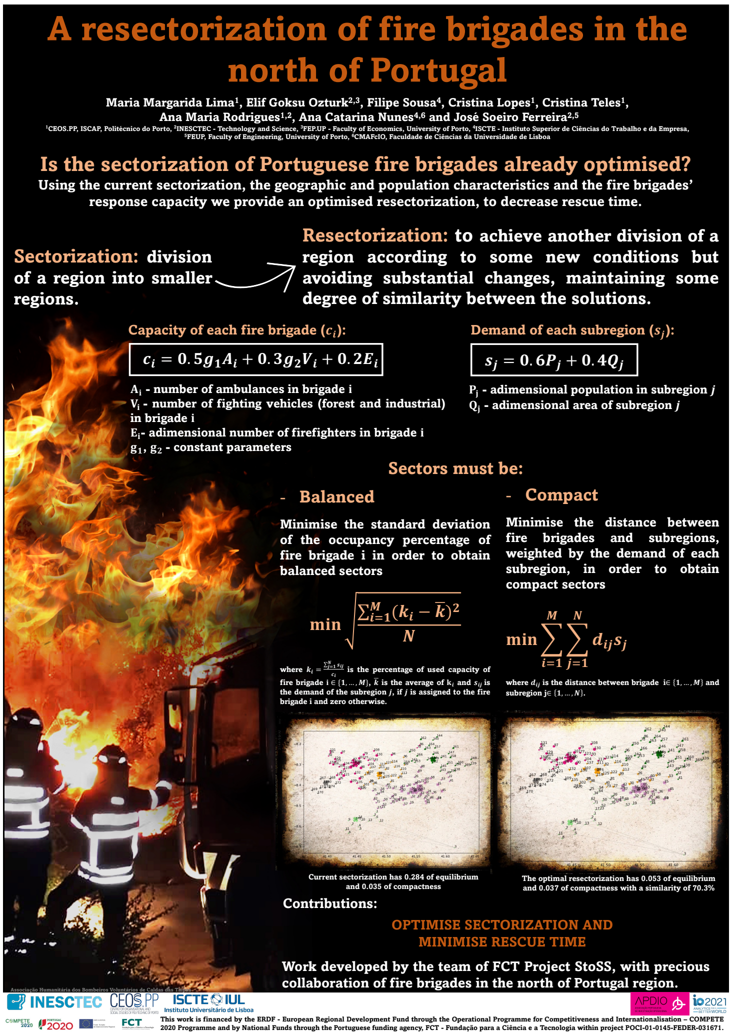
Submissão #19

A resectorization of fire brigades in the north of Portugal

Maria Margarida Lima, Elif Goksu Ozturk, Filipe S. de Sousa, Cristina Lopes, Cristina Teles, Ana Maria Rodrigues, Ana Catarina Nunes, José Soeiro Ferreira

Sectorization can be regarded as a division of a territory into smaller regions to deal with a complex problem involving multiple-criteria. Resectorization intends to achieve another sectorization, according to some new conditions but avoiding substantial changes. An example of this can be the distribution of geographical areas by fire brigades. In Portugal, fire brigades must protect and rescue the population in the areas surrounding their fire stations. So we will use the current sectorization, the geographic and population characteristics of the areas and the fire brigades' response capacity to provide an optimized resectorization, in order to decrease rescue time. To achieve that, we will use a decision support system using different optimization methods, such as Non dominated Sorting Genetic Algorithm (NSGA II), which provides an effective sectorization concerning compactness and equilibrium criteria. This work is financed by the ERDF - European Regional Development Fund through the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020 Programme and by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia within project POCI-01-0145-FEDER-031671.

Keywords: Sectorization, Resectorization, Fire Brigades, Multiple-criteria



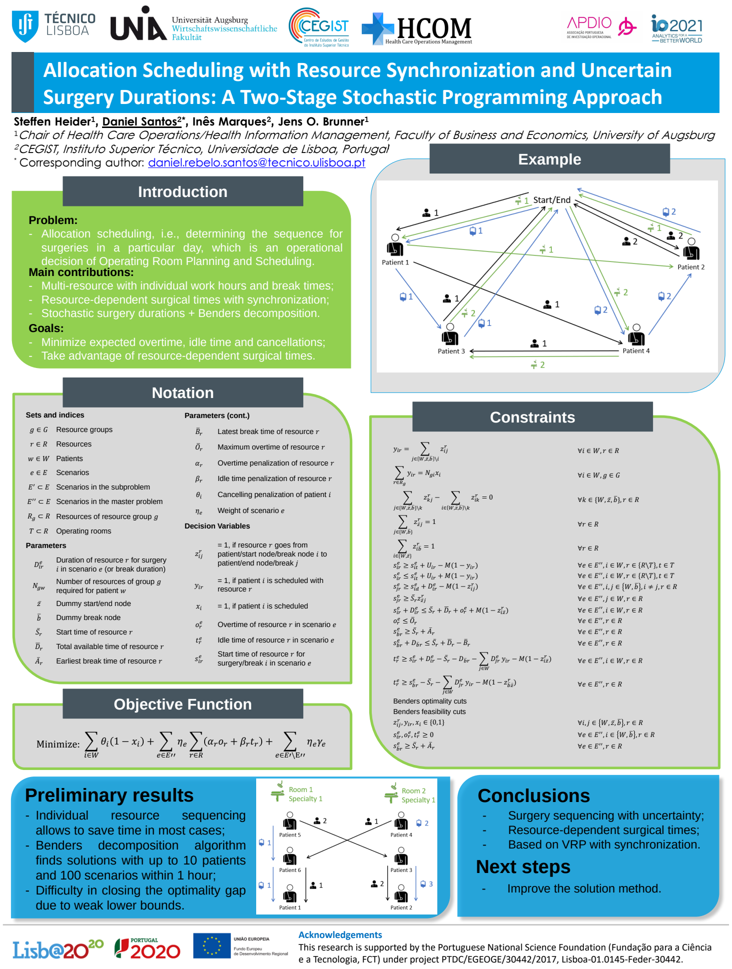
Submissão #20

Allocation Scheduling with Resource Synchronization and Uncertain Surgery Durations: A Two-Stage Stochastic Programming Approach

Steffen Heider, Daniel Santos, Inês Marques, Jens Brunner

Scheduling surgeries in a hospital is a challenging task for operating theater managers and surgeons. Many resources, e.g., rooms, surgeons, nurses, anesthetists as well as machines need to be scheduled simultaneously and need to be available at defined times of each surgery. Uncertain time of surgical sub procedures only increases the complexity. In practice, this problem is usually split in smaller subproblems where specialties are assigned to rooms and necessary resources are attached to a room, allowing specialties to schedule and sequence their surgeries independently. We present a two-stage stochastic programming model using a Benders decomposition approach to minimize idle time, overtime, and cancelled surgeries. We determine the surgery sequence and starting time for each resource including breaks and resource dependent available times, allowing for an individual patient sequence for each resource. We show that we can solve small and medium size instances to optimality.

Keywords: Elective Patient Scheduling, Synchronizaton, Uncertainty, Stochastic Programming, Benders Decomposition



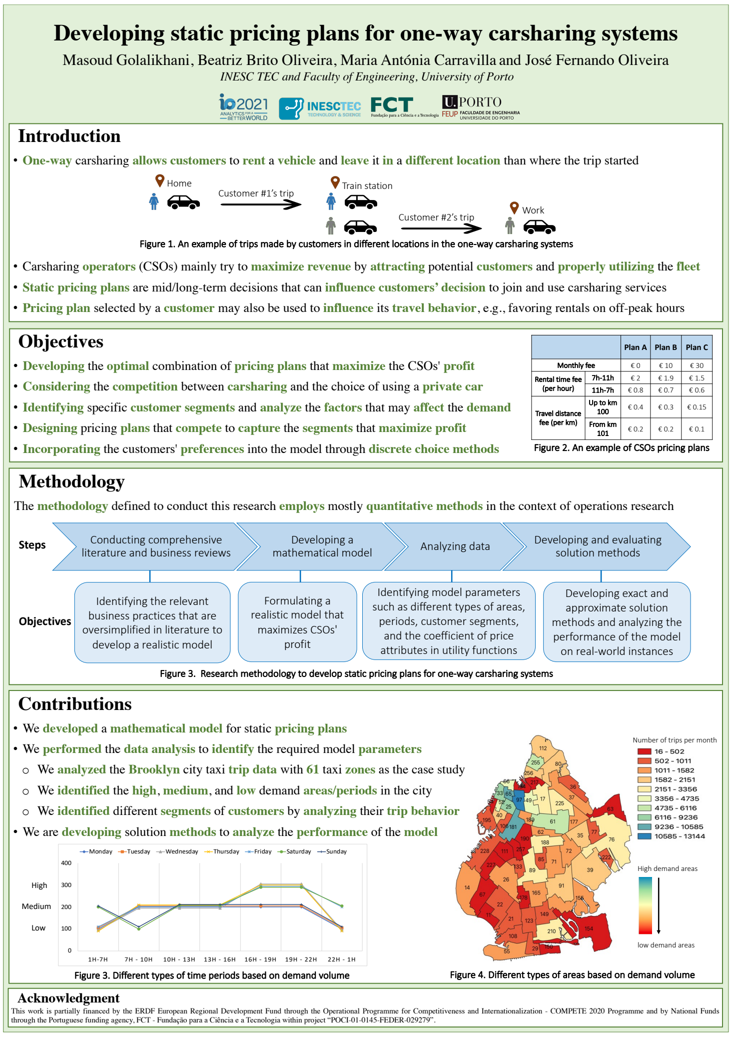
Submissão #21

Developing static pricing plans for one-way carsharing systems

Masoud Golalikhani, Beatriz Brito Oliveira, Maria Antónia Carravilla, José Fernando Oliveira

As an alternative to private cars, one-way carsharing systems allow customers to rent vehicles for a short period (e.g., minutes) and leave them in a different location than where the trip started. One of the main challenges of one-way carsharing operators (CSOs) is to maximize revenue by attracting potential customers and properly utilizing the fleet. In this regard, static pricing plans are mid/long-term decisions that influence customers' decision to join carsharing. The pricing plan selected by a customer may also be used to influence its travel behavior, e.g., favoring rentals on off-peak hours. Nevertheless, the literature often assumes a single-tariff plan for all customers (e.g., €1 per minute), while CSOs in the market offer several plans with different attributes (e.g., registration, travel distance, and rental time fees) to attract various customer segments. To fill this gap, we develop a model to design the optimal combination of pricing plans competing to capture representative segments of customers to maximize CSOs revenue, considering competition with the choice of using a private car. To this aim, we analyze customers' travel patterns and spatial-temporal factors that may affect the demand and identify specific customer segments whose preferences are incorporated in model through discrete choice methods.

Keywords: One-way carsharing, Pricing decisions, Customer segmentation



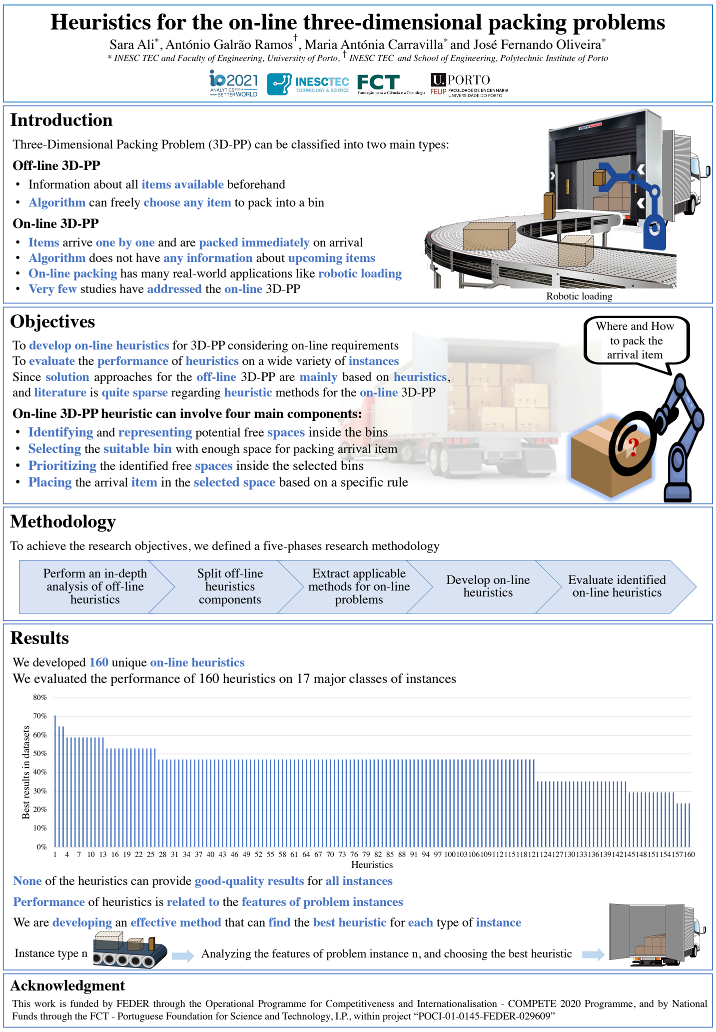
Submissão #22

Heuristics for the on-line three-dimensional packing problems

Sara Ali, António G. Ramos, Maria Antónia Carravilla, José Fernando Oliveira

The on-line three-dimensional packing problem is an NP-hard optimization problem in which items arrive sequentially over time, and at each step, the current item must be placed into containers immediately before the next item is revealed. This placement decision must be made under incomplete information about the numbers and sizes of upcoming items. On-line packing arises in many real-world problems, like robotic or automatic container loading in warehouse storage. Despite the numerous practical applications of on-line problems in real-world situations, most of the literature to date has focused on off-line problems where full knowledge about items is available beforehand. Moreover, in terms of solution approaches, the literature is quite sparse concerning heuristic methods that can be applied for solving on-line problems. Therefore, due to the crucial role of heuristic methods in finding effective solutions for real-world-sized problems in a reasonable amount of time, this study mainly focused on the development of on-line heuristic methods. The main contribution of this paper is to develop several unique on-line heuristics considering the major requirements that need to be satisfied in the on-line environments. Furthermore, we evaluate the performance of identified heuristics on a wide variety of on-line instances.

Keywords: Three-dimensional packing, On-line packing problem, Packing heuristics



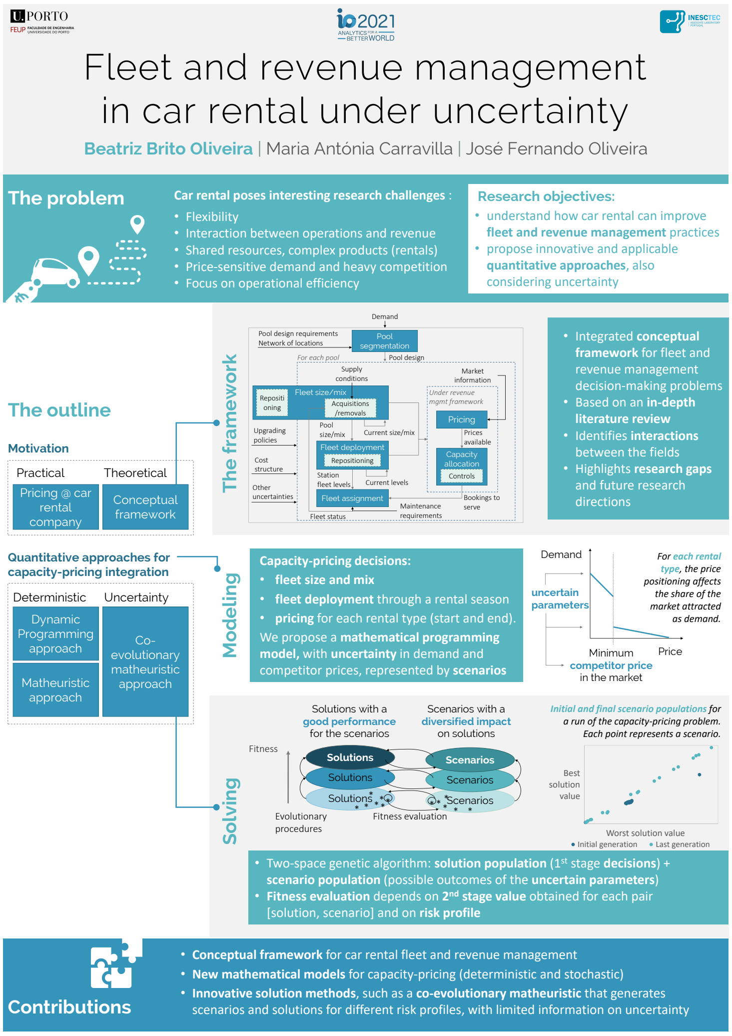
Submissão #23

Fleet and revenue management in car rental under uncertainty

Beatriz Brito Oliveira, Maria Antónia Carravilla, José Fernando Oliveira

Car rental systems face significant fleet management challenges. Additionally, their flexibility allows using pricing and other revenue management tools to influence demand. This flexibility is higher than in other traditional revenue management sectors, e.g. airlines, since it is easier to move and increase/decrease resources. This communication presents an overview of the work developed in this context, which filled a literature gap by structuring, modelling and solving the integration of fleet and revenue management problems in this business. Moreover, this work built the ground to extend the knowledge on integrating fleet and revenue management to other shared mobility applications. We studied the interactions between fleet and revenue management in car rental, proposing an integrated conceptual framework from which relevant future research directions stemmed. From there, we proposed models and solutions methods focusing on capacity-pricing problems, also considering uncertainty in demand and competitor prices. In this context, a significant number of uncertain parameters with unknown probability distributions can represent uncertainty. In such cases, we propose that metaheuristics, namely based on genetic algorithms, can generate relevant and complex scenarios. We developed an innovative approach based on a co-evolutionary metaheuristic, where solutions and scenarios are generated and evolve in parallel. (Resumo submetido no âmbito do Prémio APDIO / IO2021)

Keywords: Fleet management, Revenue management, Car rental, Optimization models, Metaheuristics



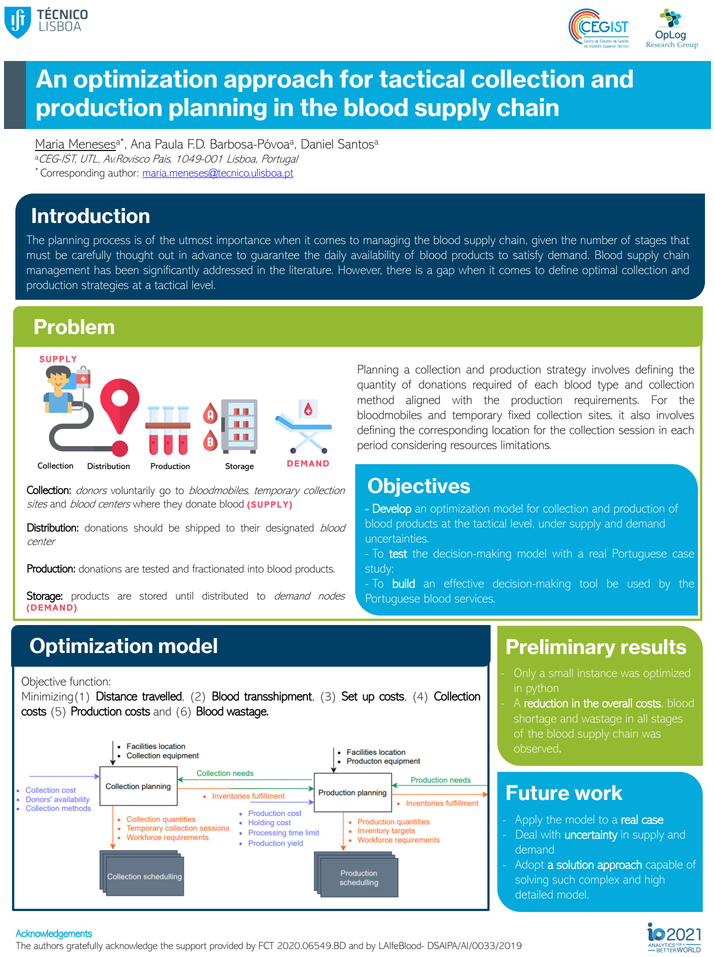
Submissão #24

An optimization approach for tactical collection and production planning in the blood supply chain

Maria Meneses, Ana Barbosa-Póvoa, Daniel Santos

Collection plays a critical role in the blood supply chain as blood is a limited resource that can only be obtained from donors. Also, it is the foundation to produce the necessary blood products. Given their perishability, production should closely mirror demand requirements to guarantee an adequate supply and avoid wastage. Such planning activities are subject to uncertainty, which adds complexity to the management of the blood supply chain. To deal with the stochastic environment whilst keeping the desired service level, it is of utmost importance to develop appropriate tools to address mid-term collection plans coupled with production balancing requirements that achieve some balance between shortages and wastage. To that end, this work presents an optimization model for collection and production of blood products at the tactical level, under supply and demand uncertainties. The proposed model considers an established blood supply chain with multiple facilities, which constrain the collection and production strategies by the limited personnel and resources capacity of the network. So, the model also optimizes the available resources. Besides, the donor pool available and respective allocation to different collection methods is addressed.

Keywords: Supply Chain Management, Optimization Modeling, Health Care



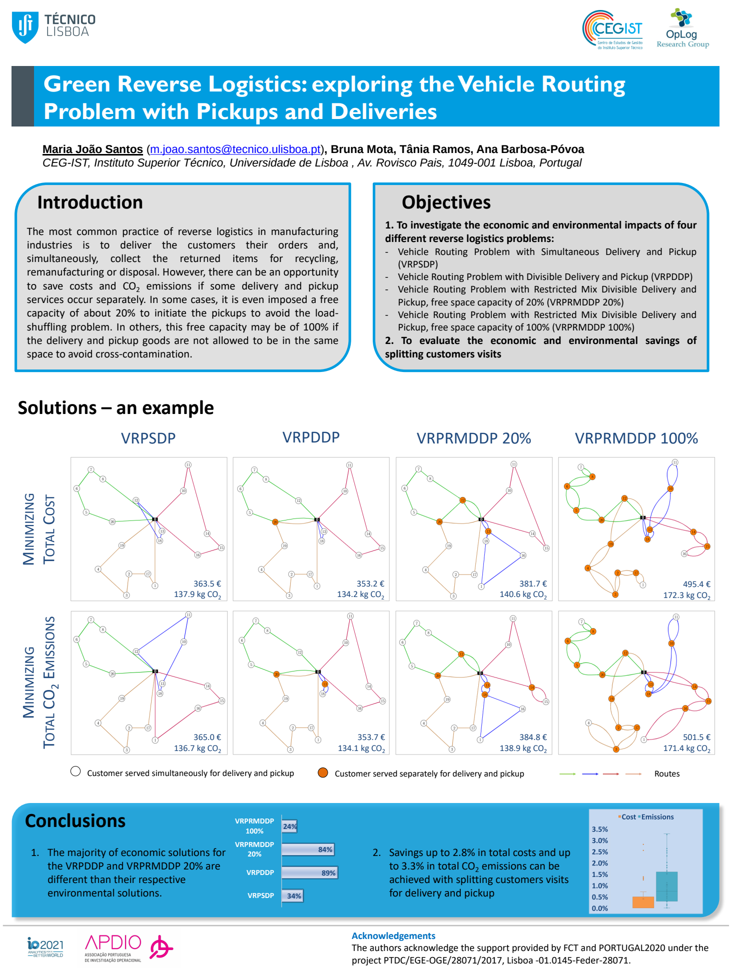
Submissão #25

Green Reverse Logistics: exploring the Vehicle Routing Problem with Pickups and Deliveries with environmental goals

Maria João Santos, Bruna Mota, Tânia Ramos, Ana Barbosa-Póvoa

The Vehicle Routing Problem with Divisible Deliveries and Pickups (VRPDDP) is under-explored in the literature, yet it has a wide application in practice in a reverse logistics context. The problem considers that each customer has both delivery and pickup demands and may be visited twice in the same or different routes. A restriction on the free capacity of the vehicles before starting the pickups to avoid load-shuffling problems may be considered. In this work, we explore the economic and the environmental impacts of the VRPDDP, with and without restrictions on the free capacity, and compares the savings achieved with splitting customers visits with the traditional Vehicle Routing Problem with Simultaneous Deliveries and Pickups (VRPSDP). The VRPDDP solutions are also characterized in terms of route shapes. A multi-objective approach based on the augmented ε-constraint method is applied to obtain and compare solutions minimizing costs and CO2 emissions. The results demonstrate that the higher is the importance of CO2 emissions in the objective function, the higher is the benefit of splitting customers. Moreover, the percentage savings of the VRPDDP are higher for instances with a random network than with a cluster network of customers, in comparison to the VRPSDP.

Keywords: Vehicle Routing Problem, reverse logistics, CO2 emissions, ε-constraint



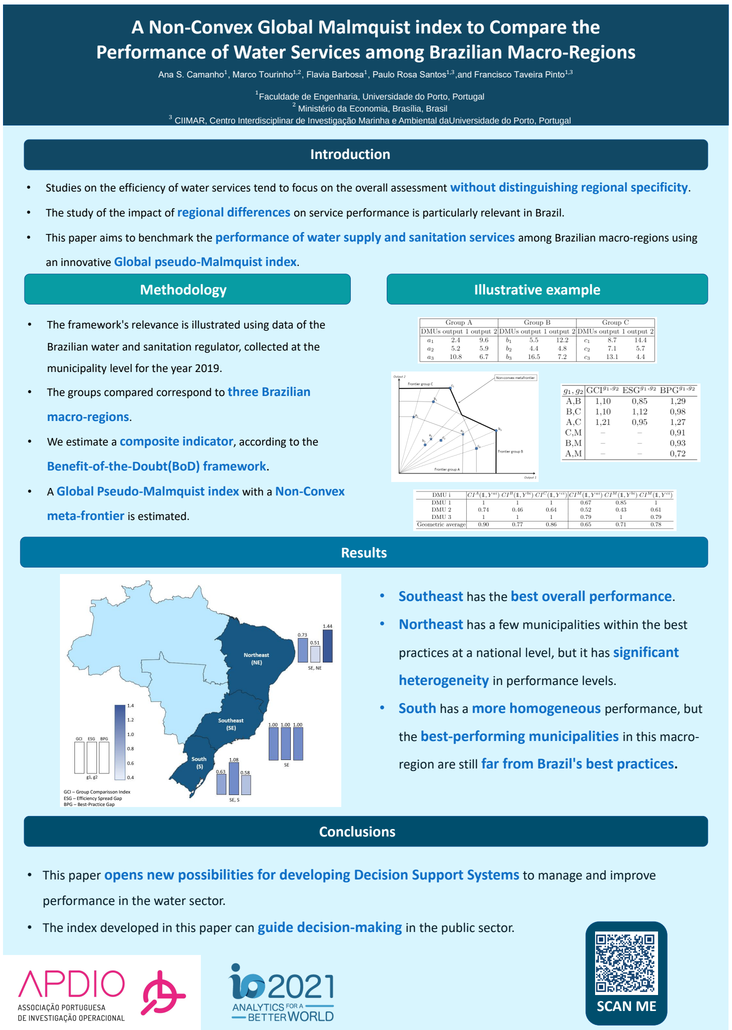
Submissão #26

A Non-Convex Global Malmquist index to Compare the Performance of Water Services among Brazilian Macro-Regions

Ana Camanho, Marco Tourinho, Flávia Barbosa, Paulo Rosa Santos, Francisco Taveira Pinto

This paper proposes an innovative framework based on optimisation techniques that can support decision-making in water services. The proposed models estimate a Best-Practice frontier recurring to a 'Benefit-of-the-Doubt' formulation that enables benchmarking performance across decision-making units. We propose an innovative estimation of a pseudo-Malmquist index to compare the performance of groups. The framework's relevance is illustrated using data of the Brazilian water and sanitation regulator, collected at the municipality level for the year 2019. The groups compared correspond to three Brazilian macro-regions. The results obtained show that the Southeast exhibits the best overall performance. The Northeast has a few municipalities with the best practices at a national level, but this macro-region has significant heterogeneity in performance levels. The South has a more homogeneous performance, but the best-performing municipalities in this macro-region are still far from Brazil's best practices.

Keywords: Malmquist index, Water services, Brazilian macro-regions, Composite Indicators, Data Envelopment Analysis



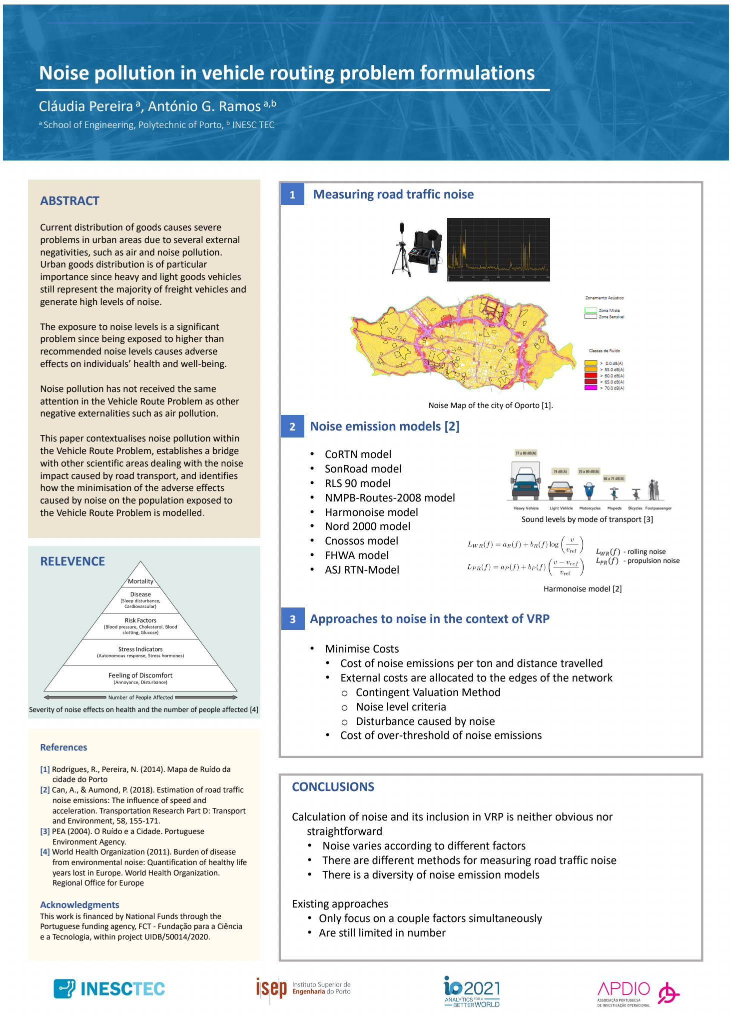
Submissão #27

Noise pollution in vehicle routing problem formulations

Cláudia Pereira, António G. Ramos

The current distribution of goods causes serious problems in urban areas due to various external negativities, such as air and noise pollution. Urban goods distribution is of particular importance, as heavy and light goods vehicles still represent the majority of freight vehicles, and generate high noise levels. Exposure to noise levels is a significant problem, as being exposed to higher than recommended noise levels causes adverse effects on the health and well-being of individuals. Noise pollution has not received the same attention in the vehicle route problem literature as other negative externalities such as air pollution. This paper contextualizes noise pollution within the Vehicle Route Problem, bridges the gap with other scientific areas dealing with the impact of noise caused by road transport, and identifies how the minimization of adverse effects caused by noise is modeled in the Vehicle Route Problem.

Keywords: City logistics, Urban freight, Transport sustainability



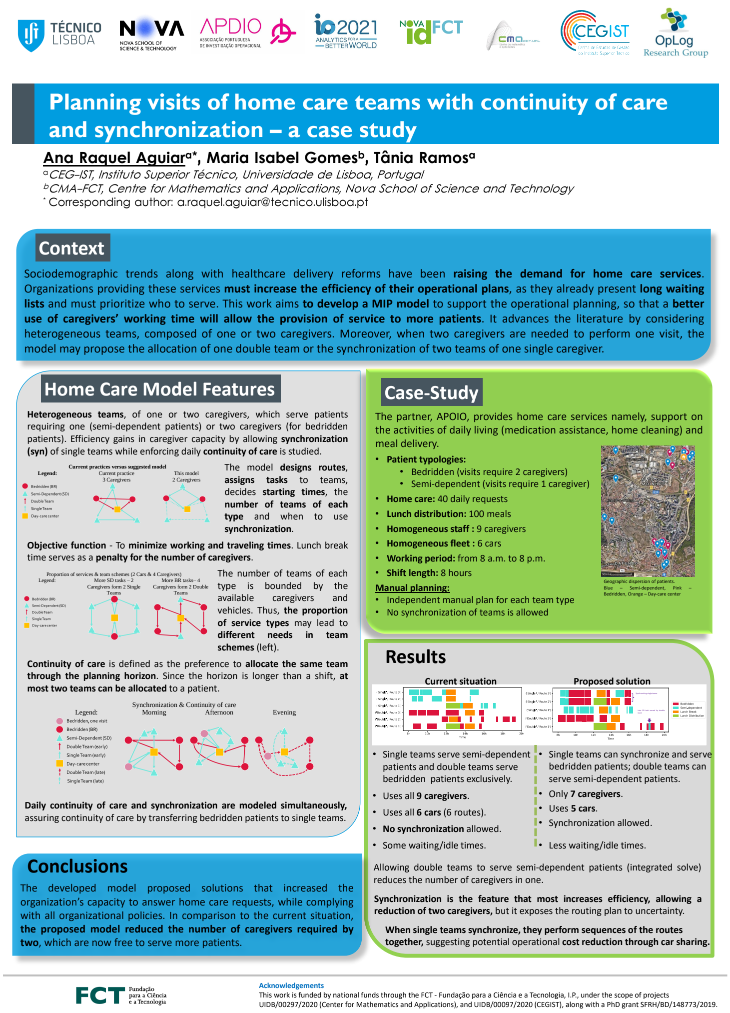
Submissão #28

Planning visits of home care teams with continuity of care and synchronization - a case study

Ana Raquel de Aguiar, Isabel Gomes, Tânia Ramos

The rising health care expenditure can be decelerated through a proper articulation between the health and social systems. An example is the early discharge of patients no longer requiring specialized medical treatment at hospitals. The care required may be provided by a combination of primary care nurses and social care provided at home. However, social organizations have difficulty in planning these visits due to the problem complexity and the inexistence of decision support systems, generating plans with poor human resource capacity allocation. APOIO is a social organization that provides care to two types of patients: semi-dependent patients, requiring visits of one caregiver, and bedridden patients, requiring two caregivers. Currently, the service is organized in two route types (one for patients requiring one caregiver and another for patients needing two caregivers), planned independently. A MIP model is proposed to support efficient planning, introducing continuity of care and synchronization of single caregiver teams in bedridden visits. Among its planning decisions are the number of teams of each type, the visits sequencing and their starting times, while minimizing total service and travel time. The solutions obtained suggest up to two fewer caregivers when compared to the current planning, enabling waiting list reductions.

Keywords: Home care, Routing and Scheduling, Mathematical Programming



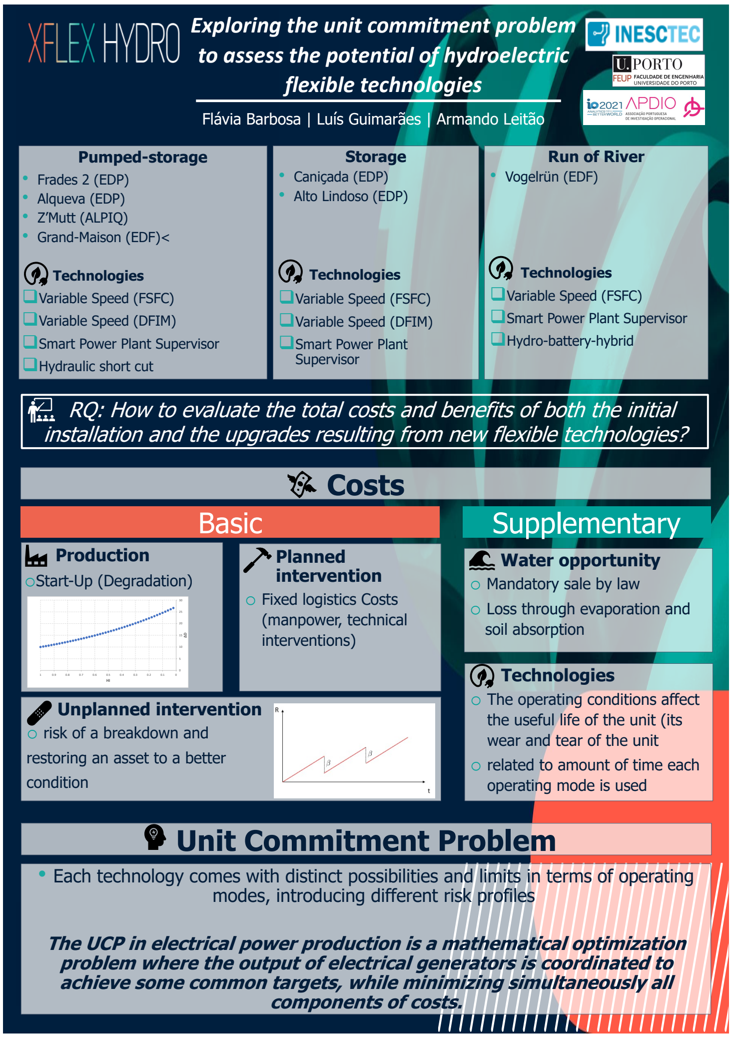
Submissão #29

Exploring the unit commitment problem to assess the potential of hydroelectric flexible technologies

Flávia Barbosa, Luis Guimarães, Armando Leitão

Hydropower plants have a very long lifetime. To evaluate the total costs and benefits of both the initial installation and the upgrades resulting from new flexible technologies, we developed a unit commitment problem (UCP) focusing on the OPEX costs. The UCP in electrical power production is a mathematical optimization problem where the output of electrical generators is coordinated to achieve some common targets. Our model minimizes simultaneously three components of costs: start-ups and planned and unplanned interventions costs. The unplanned intervention costs are computed considering the risk of a breakdown and restoring an asset to a better condition. Moreover, we evaluate the usage of the hydroelectric technologies proposed in the European project XFLEX HYDRO to provide enhanced flexibility services to the European power system. Each technology comes with distinct possibilities and limits in terms of operating modes, thus introducing different risk profiles in the operation of the units.

Keywords: Hydropower plants, Unit commitment problem, Asset management



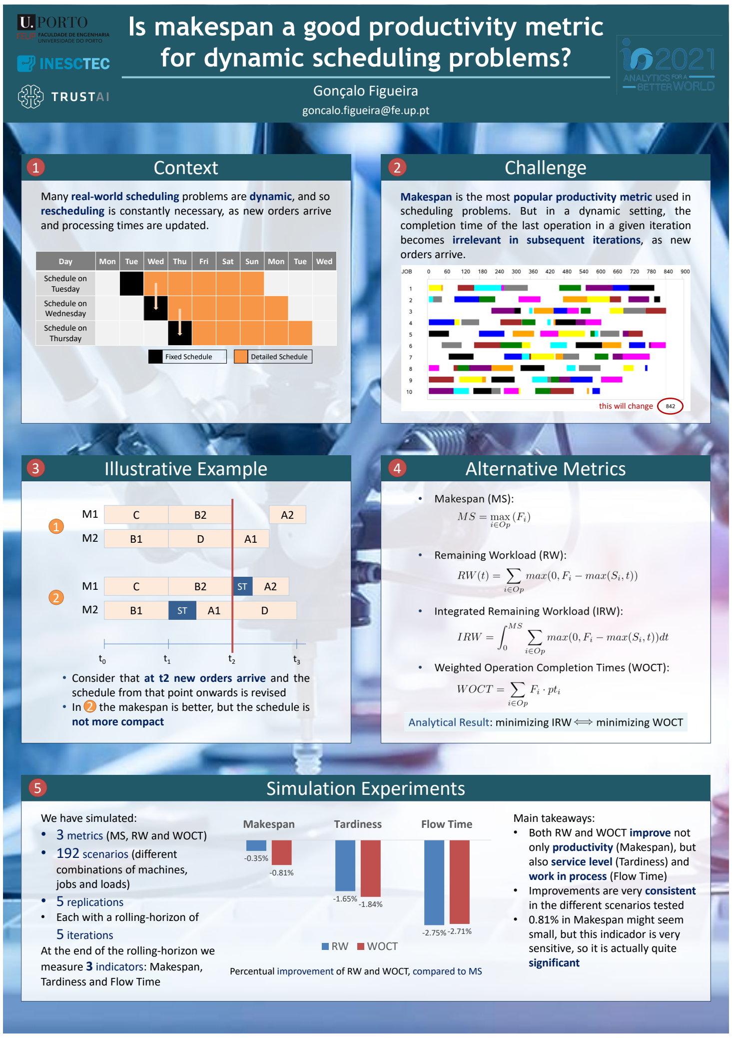
Submissão #30

Is makespan a good productivity metric for dynamic scheduling problems?

Gonçalo Figueira

Makespan is the most popular productivity metric used in scheduling problems. By promoting compact schedules, it minimizes setups, idle times and inefficiencies, while balancing machines. However, that might not work so well in many real-world settings, which are dynamic, i.e., where schedules are created/revised continuously with dispatching rules (pure online approaches), or periodically in the so-called rolling-horizon procedures. In the latter case, the completion time of the last operation (i.e., the makespan) in a given iteration becomes irrelevant in subsequent iterations, as new orders arrive. Motivated by a real-world case study of a flexible job shop setting, we investigate this issue. We propose, analyze and simulate alternative productivity metrics for this and other production settings, including classical and flexible job shops, identical and unrelated machines, and with and without sequence-dependent setup times. We show the relative performance of each metric in a variety of scenarios.

Keywords: Scheduling, Manufacturing, Real-world application



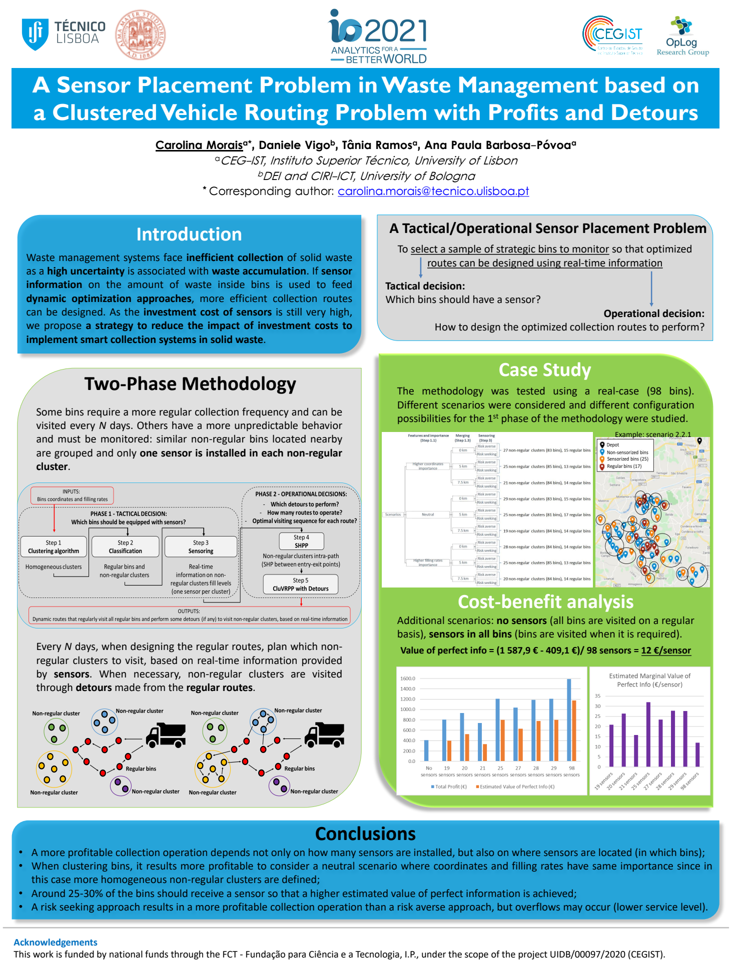
Submissão #31

A Sensor Placement Problem in Waste Management based on a Clustered Vehicle Routing Problem with Profits and Detours

Carolina Soares de Morais, Daniele Vigo, Tânia Ramos, Ana Barbosa-Póvoa

Waste management systems face inefficient collection and transportation of solid waste as a high uncertainty is associated with waste accumulation. If sensor information on the amount of waste inside bins is used to feed dynamic optimization approaches, more efficient collection routes can be designed. As the investment cost of sensors is still very high, we investigate how to select a reduced sample of bins to monitor, considering the value of information provided by sensors. To solve a sensor placement problem in waste management, we propose a two-phase methodology: in the first phase, the tactical problem of selecting a sample of bins to monitor is addressed; then, in the second phase, and depending on information transmitted by the installed sensors, a CluVRPP with Detours is operationally solved to decide the detours to take from a skeleton of routes that are regularly performed to visit unmonitored bins. A real-world problem is solved using our methodology, and three scenarios are assessed by a cost-benefit analysis: 1) no sensors - all bins are regularly visited; 2) sensors in all bins - bins are visited only when needed; 3) a set of bins is monitored - a regular route is performed and, when needed, a detour is taken.

Keywords: Logistics, Sensors, Mixed-Integer Linear Programming, Vehicle Routing Problems, Detours



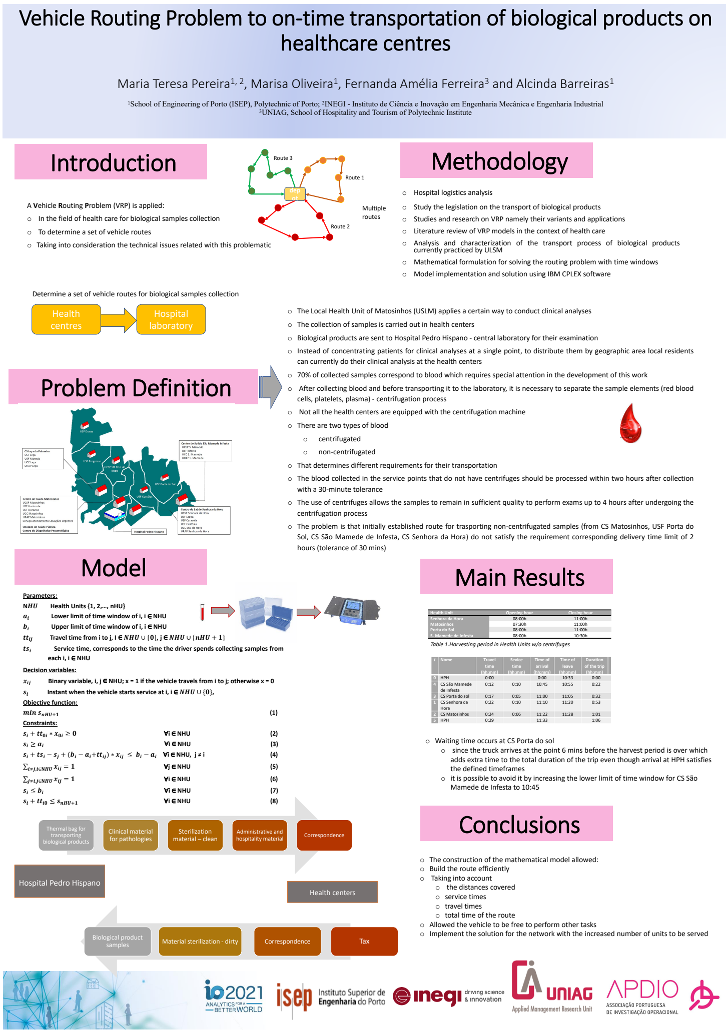
Submissão #32

Vehicle Routing Problem to on-time transportation of biological products on healthcare centres

Maria Teresa Pereira, Marisa Oliveira, Fernanda Amélia Ferreira, Alcinda Barreiras

This paper presents a Vehicle Routing Problem (VRP) applied in the field of health care to determine a set of vehicle routes to perform on-time transportation of biological products from the health centres where they are collected from the patients to the hospital laboratory for further processing and analysis, taking into consideration the technical issues related with this problematic. The project work is intended to deploy an existing solution in CPLEX software and to develop Vehicle Routing Problem with Pick-Ups and Deliveries (VRPPD) in a way it is possible to perform effectively collections of biological products and at the same time deliver medical supplies such as gloves, masks, sanitation accessories and disposable tools to the health units. In addition, it is aimed to implement the solution for the network with the increased number of units to be served. The construction of the mathematical model allowed to build the route efficiently, taking into account the distances covered, service times, travel times, total time of the route and allowed the vehicle to be free to perform other tasks. Acknowledgments: This work is funded by the European Regional Development Fund through the Regional Operational Program North 2020, within the scope of Project GreenHealth-Digital strategies in biological assets to improve well-being and promote green health, Norte-01-0145-FEDER-000042.

Keywords: VRP, Transportion, biological products, Healthcare



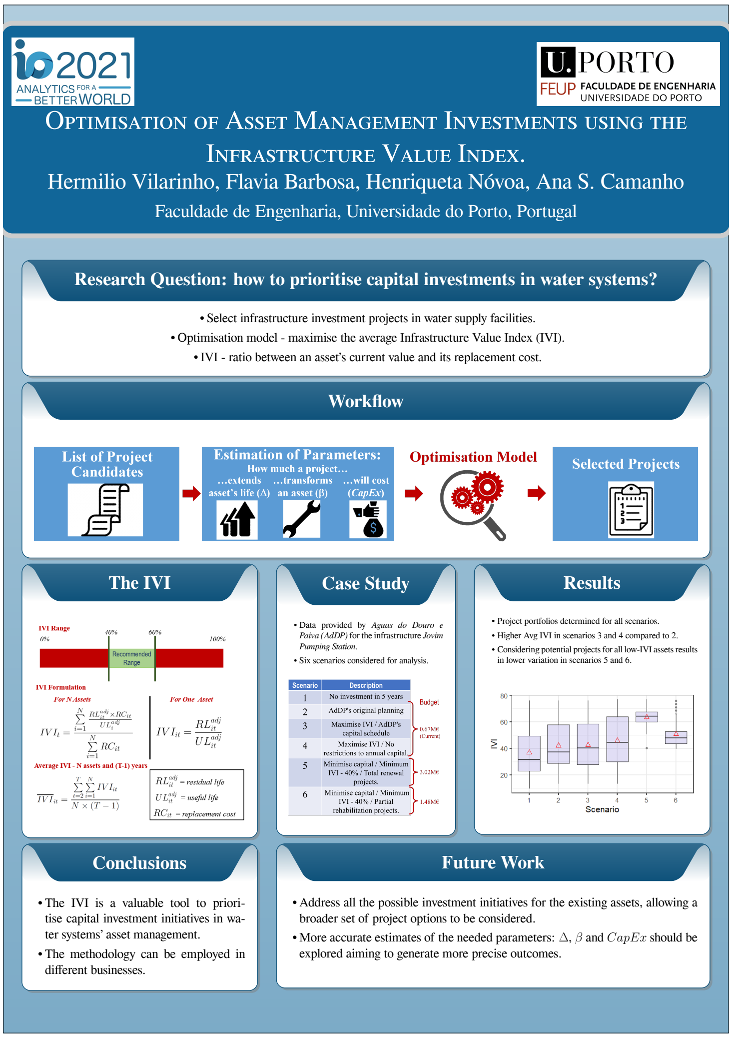
Submissão #33

Optimisation of Asset Management Investments using the Infrastructure Value Index

Hermilio C. Vilarinho Fernandes, Flávia Barbosa, Henriqueta Nóvoa, Ana Camanho

Proper management of water infrastructures is crucial to enhance the three sustainability dimensions of urban settings: better water services for the People, respect for limited water resources in the Planet, and Prosperity. This work proposes a novel approach to select infrastructure investment projects in water supply facilities under the framework of asset management. The proposed optimisation model chooses the portfolio of projects that maximise the Infrastructure Value Index (IVI). The IVI has been discussed as a tool to characterise water service infrastructure and address investment planning to overcome risks. It was initially designed as the ratio between an asset's current value and its replacement cost and is currently applied for asset management by Portuguese water companies. The use of the model is demonstrated with data provided by a real-world case study. The results obtained were discussed and validated with company managers. This research shows that the IVI is a valuable tool to prioritise capital investment initiatives in water systems, and its use can be extended to infrastructures in other sectors.

Keywords: Asset management, Capital investment planning, Infrastructure value index, Performance indicator, Optimisation



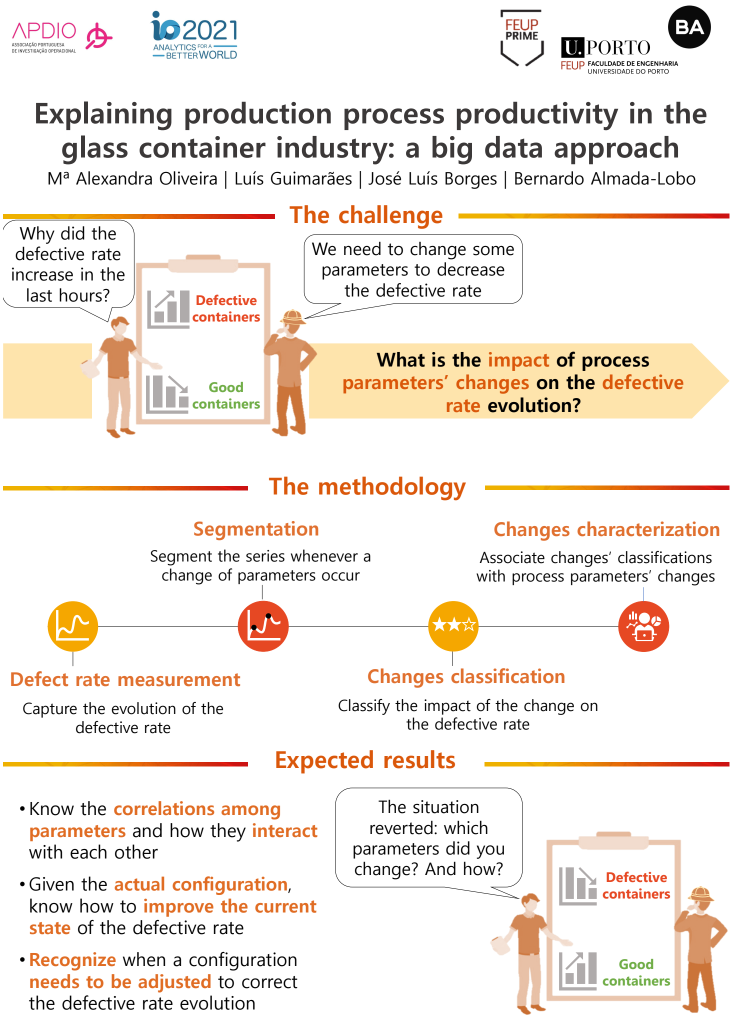
Submissão #34

Explaining production process productivity in the glass container industry: a big data approach

Maria Alexandra Ramalho de Oliveira, Luis Guimarães, José Borges, Bernardo Almada-Lobo

The current global market is defined by high competitiveness, caused mainly by increased supply and customer expectations. Faced with this scenario, companies must strive to be more efficient and effective, so quality and productivity play a significant role. The capability to improve both the quality and productivity of the delivered service will dictate the company's position in the market. With the rise of Industry 4.0, it became clear for organizations the importance of analyzing the vast amounts of data generated over the years by their core processes. This work is motivated by a collaboration with the largest Portuguese glass container manufacturer. The goal is to minimize production losses by leveraging data-driven models to support and optimize decision-making. However, the dispersion of data increases the difficulty of replicating the best historical production cycles and creates challenges in understanding the quality defects causes. Therefore, it is crucial to understand the process in the first stage by diagnosing the production losses behavior. We present an approach to identify patterns in the containers' defective rates and explain them by estimating the impact of controllable and uncontrollable production process variables. Resulting from the application of the proposed work, we expect to decrease production losses, reduce the dependency on worker's experience, and understand the causes of the identified patterns.

Keywords: Glass container production, Process improvement, Machine learning



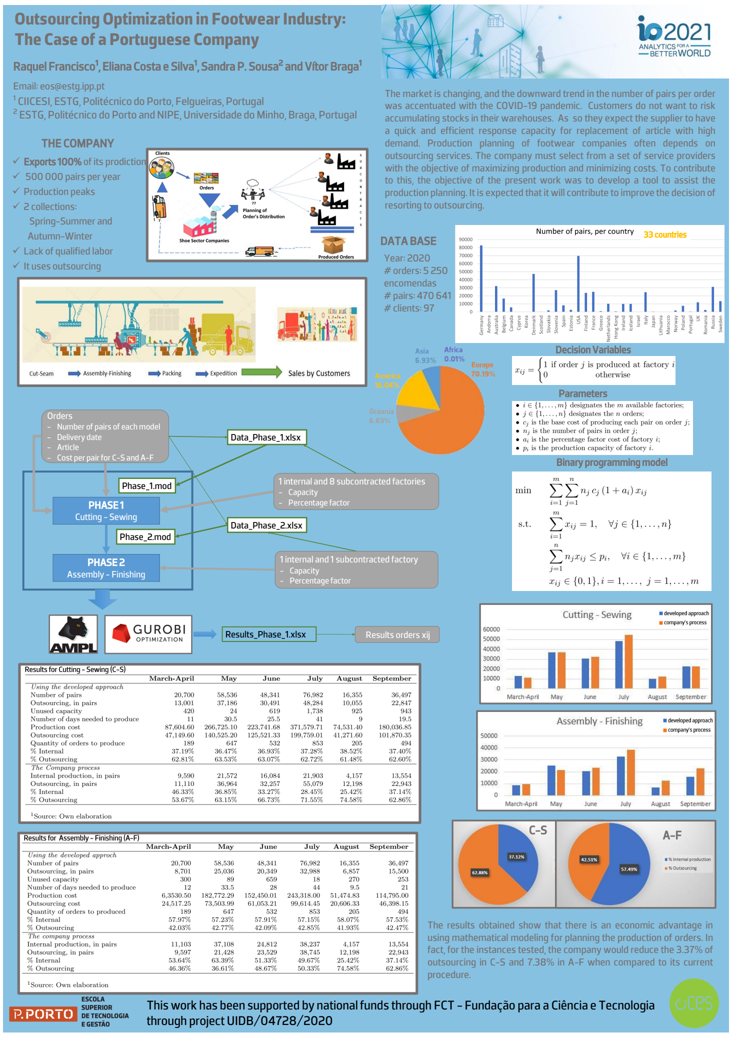
Submissão #35

Outsourcing Optimization in Footwear Industry: The Case of a Portuguese Company

Raquel Francisco, Eliana Costa E Silva, Sandra P. Sousa, Vítor Braga

In the footwear industry, when market's demand exceeds the company's manufacturing capacity, subcontracting is generally considered. The downward trend in the number of pairs per order was accentuated with the COVID-19 pandemic. In order to give a quick and efficient response to customers', several companies consider that each order can, in principle, be assigned for internal or external production. The present work presents an empirical study with real data from a company in the footwear sector located at the Tâmega e Sousa Region. The aim is to propose a model for assisting in the production planning decision-making process, for the two main phases in the manufacturing process. With the aim of minimizing the overall cost, each order must be assigned for one of the available subcontractors or for internal production, while taking into account the conditions that most influence the processes. One year data, provided by the company, is used to test the model, considering biweekly and monthly planning. Furthermore, taking the company's current process, grouping the orders of the same article, is also consider in the tests. The results show the economic advantage in using mathematical modeling. In fact, for the tested instances cost reductions were found in both phases of the manufactured process. This work has been supported by national funds through FCT - Fundação para a Ciência e Tecnologia through project UIDB/04728/2020

Keywords: Outsourcing, Footwear Industry, Binary Linear Programming, Assignment Problem



Submissão #36

Um modelo de decisão bi-objetivo para otimização de portefólios de projetos em serviços administrativos

Jorge Noro, Luis Dias

Este trabalho apresenta um modelo bi-objetivo de otimização para a gestão de portefólios de projetos, centrado no compromisso dos agentes. O modelo maximiza os ganhos (económicos) do portefólio enquanto assegura o compromisso da equipa com a organização. O desenvolvimento de competências dos agentes também é considerado, de modo a melhorar o desempenho da equipa ao longo do tempo. A formulação permite selecionar quais os projetos a serem implementados e por quem. A afetação dos projetos considera a carga de trabalho de cada agente, as suas competências e a forma como essa alocação de novos projetos afeta os seus compromissos com o serviço, através das dimensões de Absorção, Dedicação e Vigor da escala de UWES (escala de compromisso com o serviço de Utrecht), na sua forma reduzida. São apresentados resultados experimentais, num cenário baseado na experiência de serviços administrativos de suporte a projetos de investigação e inovação.

Keywords: Gestão de portefólios de projetos, Compromisso dos agentes com o serviço, Otimização multi-objetivo

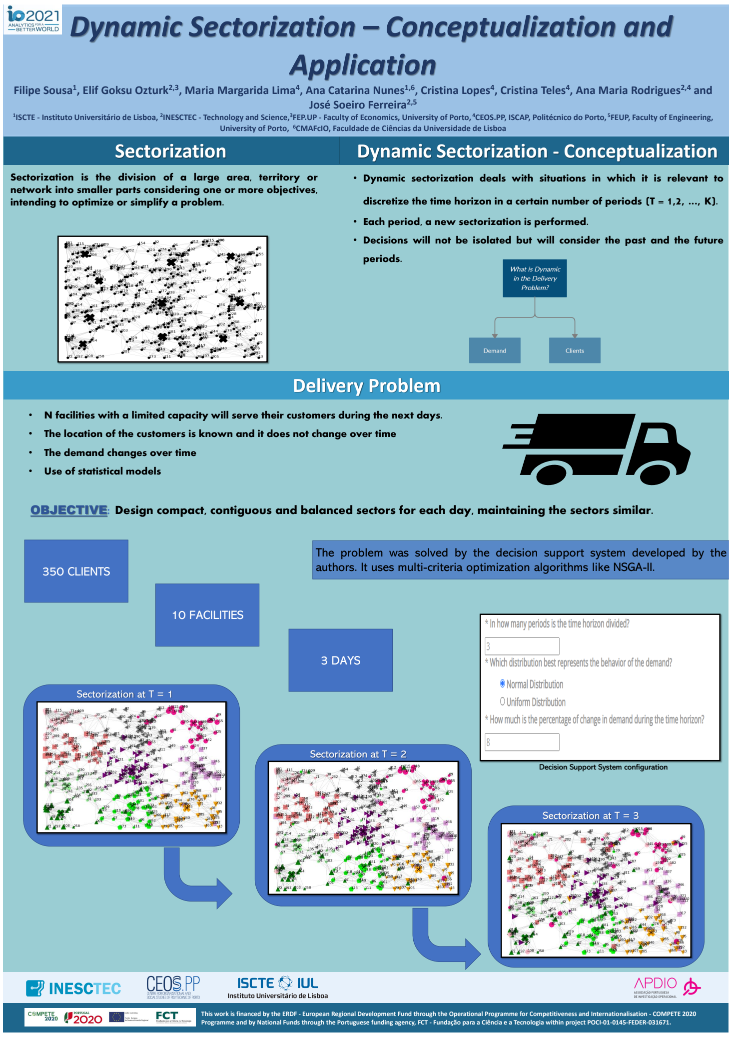
Submissão #37

Dynamic Sectorization - Conceptualization and Application

Filipe S. de Sousa, Elif Goksu Ozturk, Maria Margarida Lima, Ana Catarina Nunes, Cristina Lopes, Cristina Teles, Ana Maria Rodrigues, José Soeiro Ferreira

Sectorization is the division of a large area, territory or network into smaller parts considering one or more objectives, intending to optimize or simplify a problem. Dynamic sectorization deals with situations where it is convenient to discretize the time horizon in a certain number of periods. Certainly, the decisions will not be isolated, but they will consider the past and the forthcoming periods. The application areas are diverse and increasing due to the uncertain times in which we live. For example, solving this problem can be useful for delivery companies where the demand is always changing. We propose a conceptualization of dynamic sectorization and apply it to a problem under research related to distribution with variable demand. Furthermore, the solution to that problem is obtained using a Decision Support System developed by the authors. This work is financed by the ERDF - European Regional Development Fund through the Operational Programme for Competitiveness and Internationalisation - COMPETE 2020 Programme and by National Funds through the Portuguese funding agency, FCT - Fundação para a Ciência e a Tecnologia within project POCI-01-0145-FEDER-031671.

Keywords: Sectorization, Dynamic Sectorization, Decision Support System



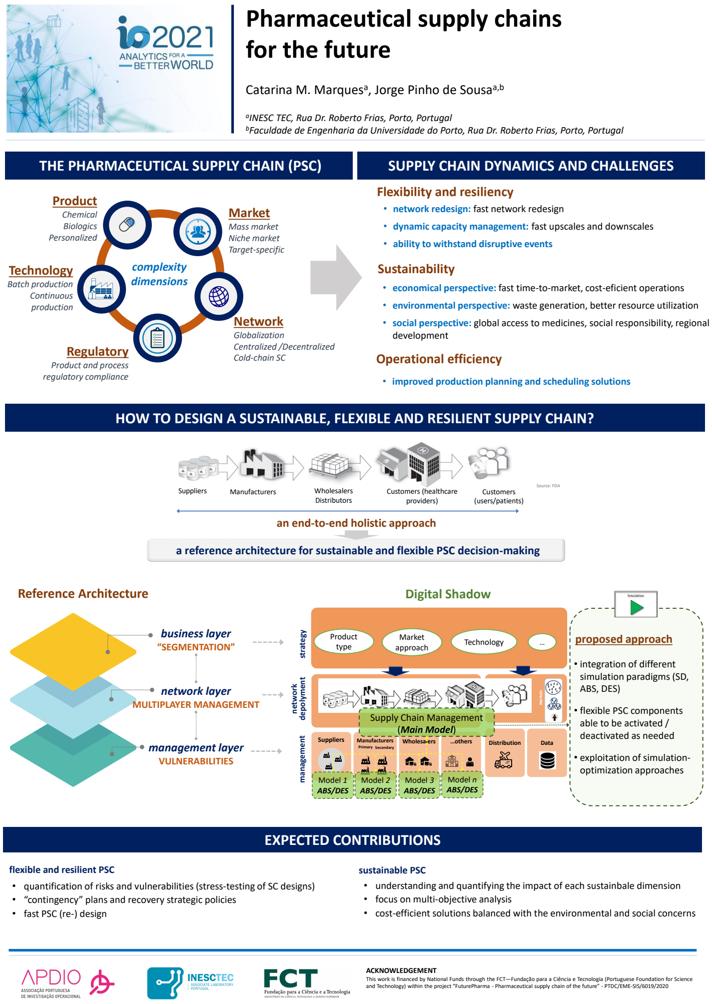
Submissão #38

Pharmaceutical supply chains for the future

Catarina Marques, Jorge Pinho de Sousa

As never before, the COVID-19 pandemic has shown the extraordinary importance of the pharmaceutical industry and its supply chains. In fact, not only pre-existent supply chain weaknesses are being exposed and aggravated, but also technological breakthroughs and operational innovations have been boosted by the urgent need for a fast and direct response to the pandemic. Even if these recent operational initiatives seem to defy some of the current management paradigms, one needs to understand how they will endure in the future. This is particularly relevant to guarantee these general approaches will ensure an uninterrupted and efficient worldwide supply of innovative medicines. In this context, this work aims to present a comprehensive overview of the industry most prominent challenges, as well as to understand the pharmaceutical supply chain network dynamics and idiosyncrasies, in order to develop a reference architecture for supporting high-level decision-making. The main purpose of such architecture is to fast-track vulnerabilities along the distribution chain, and to anticipate the resulting risks propagation across the network in several uncertainty scenarios. This assessment is expected to provide insights to build both proactive operations strategies and reactive plans, fostering enhanced supply chain resiliency and flexibility.

Keywords: Pharmaceutical supply chain, Resiliency, Flexibility, Simulation-optimization, Uncertainty



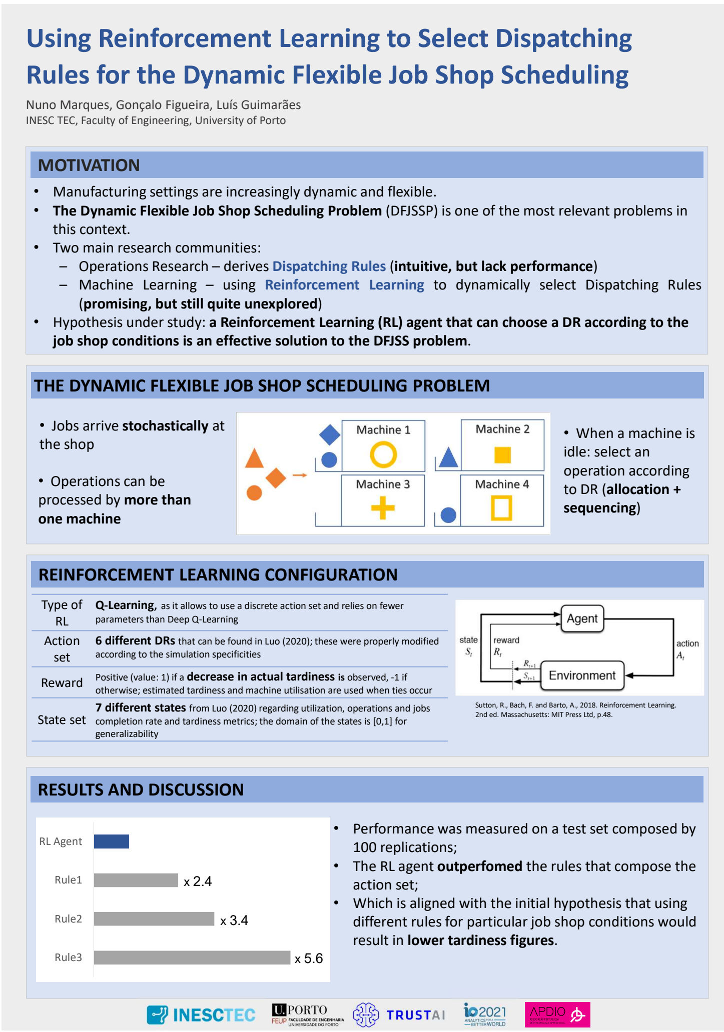
Submissão #39

Using Reinforcement Learning to select Dispatching Rules for the Flexible Job Shop Scheduling

Nuno Marques, Gonçalo Figueira, Luis Guimarães

With the rise of Industry 4.0, organizations must keep up with the technological evolution and fierce competition. Under this paradigm shift, operations management problems in general, and production scheduling in particular, present new challenges, such as real-time decision making. Therefore, reactive methods such as Dispatching Rules (DRs) are reemerging as a popular choice in dynamic scheduling due to their interpretability, simplicity and overall satisfactory performance in uncertain environments. Over the years, researchers have combined simpler rules to form more performant ones, the so-called Composite Dispatching Rules (CDRs). These studies resort either to extensive domain knowledge to manually compose them, or to methods that automatically generate CDRs, such as, Random Forests or Genetic Programming. Even though CDRs present good performance, the literature is unanimous to state that there is not one rule that works well across diverse Scheduling conditions, that is, light to heavy utilisation and tight to loose due dates. Therefore, this work aims at investigating the suitability of using a Reinforcement Learning (RL) agent. RL's main advantage is its adaptability, as RL agents continuously learn by collecting new observations from the environment. However, key issues, such as the reward function and computational effort, might compromise its performance.

Keywords: Production Scheduling, Reinforcement Learning, Flexible Job Shop, Industry 4.0



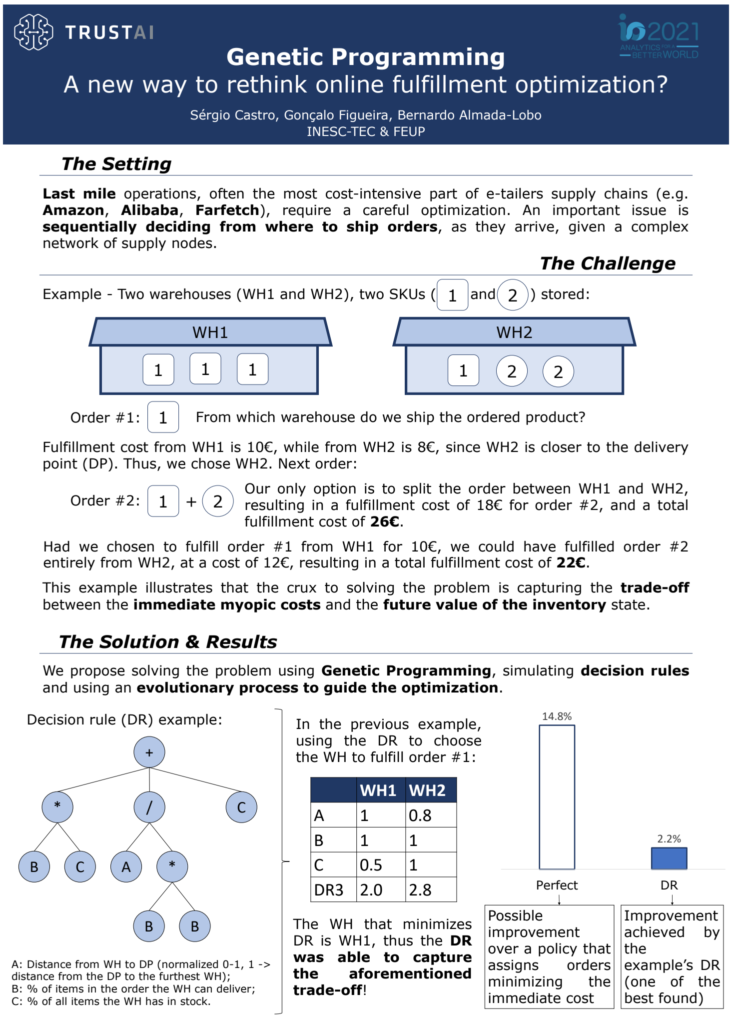
Submissão #40

Genetic Programming: a new way to rethink online fulfillment optimization?

Sérgio Castro, Gonçalo Figueira, Bernardo Almada-Lobo

Online retail represents around 18% of global retail sales. As its growth shows no sign of slowing down, practitioners still face many unresolved challenges. Last mile delivery costs in online retail are often higher than in traditional retail due to the need to ship items from a fulfillment center to a customer address, which results in a challenging dynamic optimization problem. We have investigated an approach based on genetic programming for the online order fulfillment problem. The main advantage over mathematical programming approximations, which dominate the literature, is the easiness in inspecting, reproducing and implementing decision rules. These are critical features for adoption by practitioners. Decision rules were trained and tested on a set of instances that approximate real-world settings. Results show: (1) an improvement of 2,4% over the myopic policy, capturing around 16% of the improvement gap between the myopic policy and a perfect hindsight solution; (2) an improvement of the performance of the generated decision rules with a higher crossover probability and a lower limit on the maximum tree depth; and (3) the most relevant terminals are those related to the problem's costs function, namely the distance to the order location, and the ability to fulfill multi-item orders.

Keywords: Online Fulfillment, Dynamic Optimization, Genetic Programming, Machine Learning



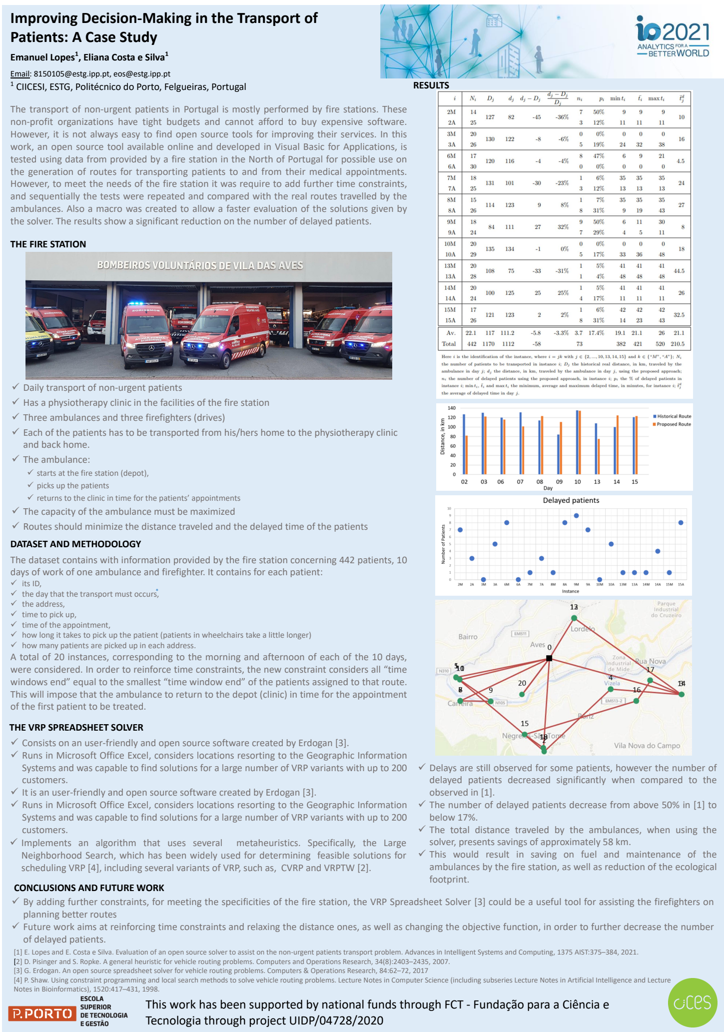
Submissão #41

Improving Decision-Making in the Transport of Patients: A Case Study

Emanuel Lopes, Eliana Costa E Silva

The transport of non-urgent patients in Portugal is mostly performed by fire stations. These non-profit organizations face budget limitations. Therefore, it is essential to make a better use of the existent resources. Furthermore, the COVID-19 pandemic and the urgency to reduce the environmental impact of Human activities, enhances the need to improve patients' transportation. There has been efforts to develop solutions to assist these organizations. However, most of the solutions do not fit the reality or are not user friendly to be adopted by fire stations. Previously, the open-source VRP solver by Erdogan (2017) was examine using instances extracted from real data provided by a fire station. The fire station daily transports patients from their homes to the clinic located at its facilities. Although, the VRP solver was able to yield solutions in an acceptable run time, delays above an acceptable number were observed. In the present work, adaptations were made to meet the needs of the fire station. Specifically, constraints on arrival time to the clinic, based on the earliest appointment of the transported patients, were added. Also, several parameters were tuned and a macro was created for a faster evaluation of the solutions. The results show a reduction on delays and on the distances. This work has been supported by national funds through FCT - Fundação para a Ciência e Tecnologia through project UIDP/04728/2020.

Keywords: Vehicle Routing Problem, Metaheuristics, Large Neighborhood Search Algorithm, Health Care, Transport of Non-urgent Patients



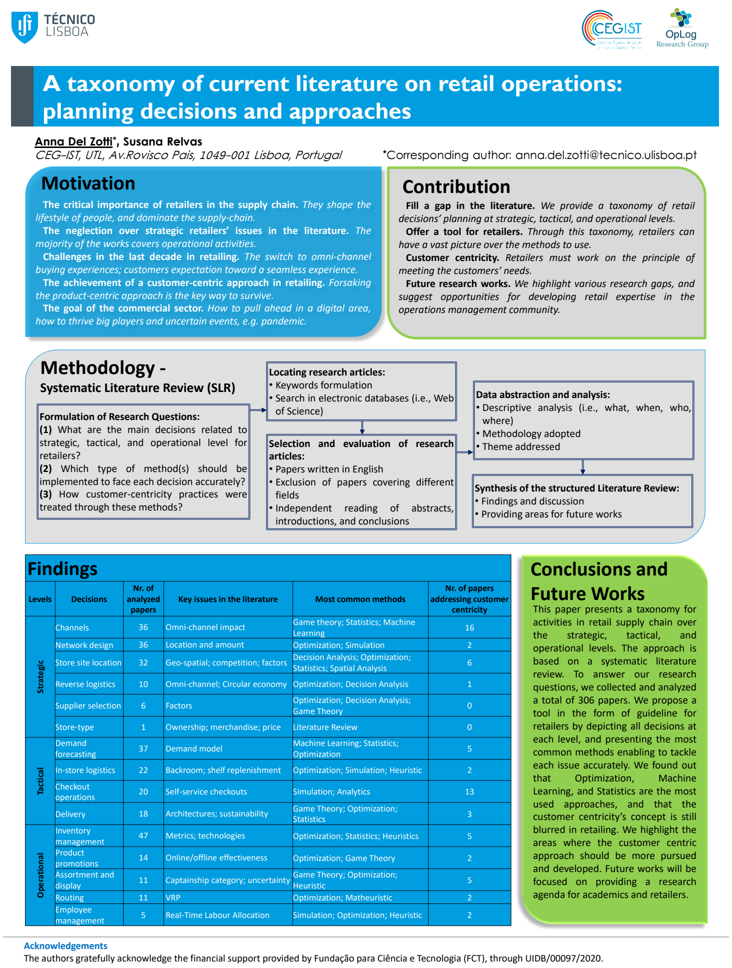
Submissão #42

A taxonomy of current literature on retail operations: planning decisions and approaches

Anna Del Zotti, Susana Relvas

Retailers must embrace a customer-centric approach over operations in the retail supply chain to compete and endure effectively in the current disrupted digital market. Thus, they must be agile and forward-thinking in the use of relevant methods to make suitable decisions and address ongoing difficulties. This work aims to (1) provide a taxonomy of current literature on retail decisions' planning at the strategic, tactical, and operational levels; and (2) review trends and directions of approaches to address the above decisions towards the achievement of customer-centricity and decision compatibility across the three levels of planning in the retail supply chain. The current work is based on a categorization process that emphasizes the importance of managing a retail business as an integrated system, rather than considering each level separately without coordination among levels, by identifying customers' needs and pain points and then developing a solution to sell them, placing the customer at the center of all strategies. Finally, by addressing the limitations inherent in this study, we highlight various research gaps and suggest opportunities for developing retail expertise in the operations management community. To answer our research questions, we collected and analyzed a total of 308 papers.

Keywords: Retail Operations, Retail Supply Chain, Decision Levels, Customer-centric Approach



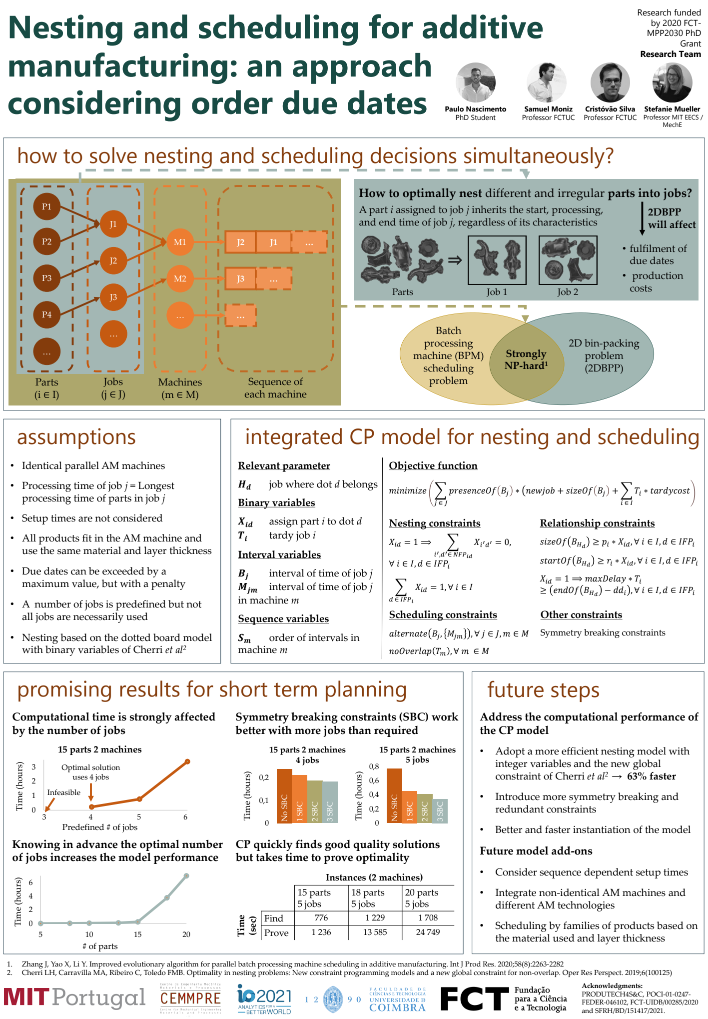
Submissão #43

Nesting and scheduling for additive manufacturing: an approach considering order due dates

Paulo Nascimento, Samuel Moniz, Cristóvão Silva, Stefanie Mueller

Additive manufacturing (AM) is an emerging production technology that is gaining enormous popularity in manufacturing systems, facing its industrialization phase. However, to adopt this technology, adequate scheduling of the AM machines is critical to guarantee the desired levels of efficiency. AM has unique characteristics such as producing parts with different materials, areas, heights, and volumes in the same building platform, which require integrating nesting (2D bin packing) decisions with scheduling decisions. Moreover, producing different parts simultaneously in the same building platform means that a part inherits the completion time of the assigned batch even if it is completed much sooner. Thus, this paper investigates and proposes a formulation to solve the problem of nesting and scheduling of parallel AM machines, while considering the satisfaction of order due dates. The integration of nesting with scheduling, as well as the consideration of different due dates, are often neglected aspects in the relatively small existing literature on AM scheduling. An example motivated by an industrial case is used to demonstrate the applicability of the proposed formulation and the importance of adequate scheduling of AM machines.

Keywords: Additive manufacturing, Scheduling, Nesting, Bin packing, Mathematical programming, Production planning



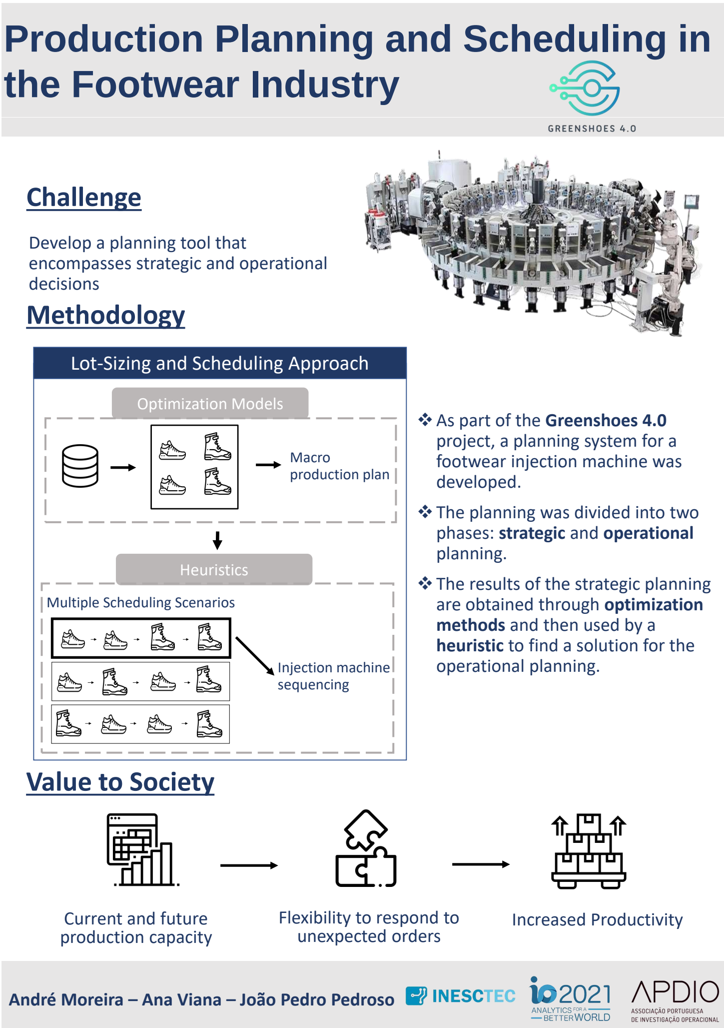
Submissão #44

Production Planning and Scheduling in the Footwear Industry

André Moreira, Ana Viana, João Pedro Pedroso

In recent years, the Portuguese footwear industry has changed drastically. What used to be a low-cost mass production industry has changed to retail chains dealing with small orders and personalized footwear. These changes increase the demand for flexible and fast production lines, able to deliver orders of any size. This paper deals with production planning for the injection line of a company producing safety shoes. In this study, a new method for long/medium-term planning is proposed to balance the production over the following weeks, minimizing the production costs, stocks and backlog requirements. This is complemented with a short-term planning (sequencing) algorithm for dealing with operational requirements. In order to solve both problems simultaneously, a method iterates between the midterm lot-sizing problem and the scheduling a heuristic, adjusting the capacity considered in lot-sizing if the scheduling problem turns out to be infeasible. Results obtained show that the company can significantly benefit from this new planning method.

Keywords: Lot-Sizing, Scheduling, Production Planning



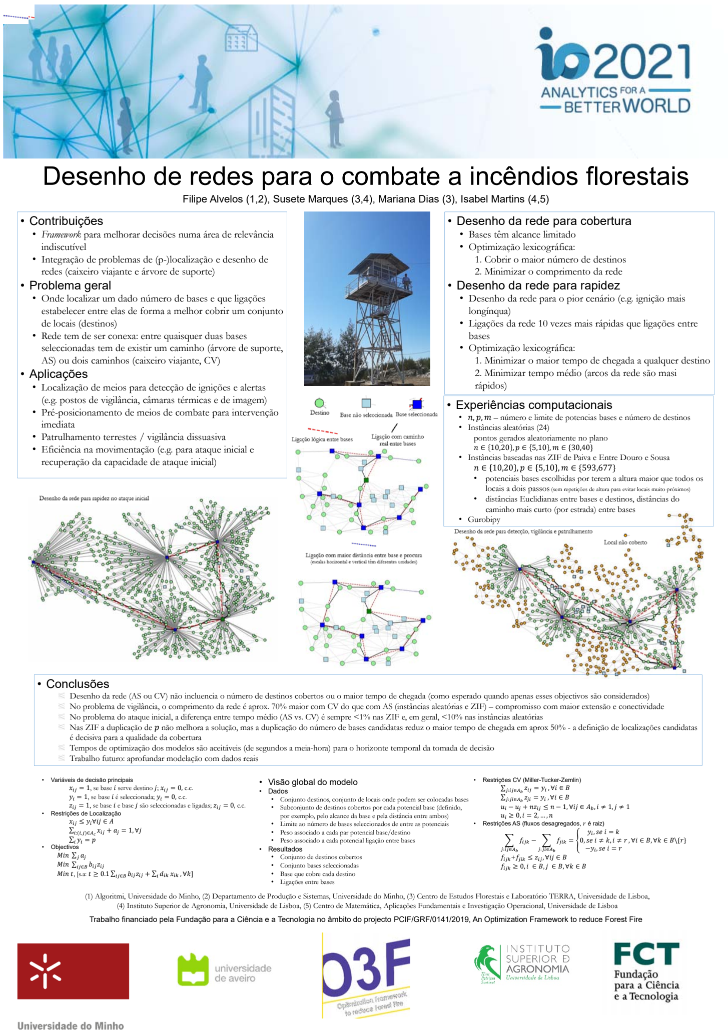
Submissão #45

Desenho de redes para o combate a incêndios florestais

Filipe Alvelos, Susete Marques, Mariana Dias, Isabel Martins

O tempo de resposta a uma ignição é um factor crucial no sucesso do combate aos incêndios florestais. Neste trabalho, propõe-se a construção/operacionalização de uma rede viária que facilite a movimentação de meios para a vigilância, pré-posicionamento e ataque inicial de incêndios florestais. A rede é definida por um conjunto de bases e das estradas que as unem e o seu desenho tem com função garantir que é possível chegar de uma base a qualquer local de uma potencial ignição dentro de um tempo limite pré-determinado ou, não sendo possível chegar a todos, chegar ao maior número de potenciais locais de ignição. Com base em modelos de programação inteira mista que combinam p-localização com caixeiro viajante e com árvore de suporte, analisam-se duas potenciais configurações da rede: em anel e em árvore. Discutem-se diferentes objectivos e a incorporação de incerteza nos locais de ignição. Este trabalho foi realizado no âmbito PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire"financiado pela FCT, Fundacão para a Ciência e Tecnologia.

Keywords: Incêndios florestais, Programação inteira mista, Redes, Cobertura



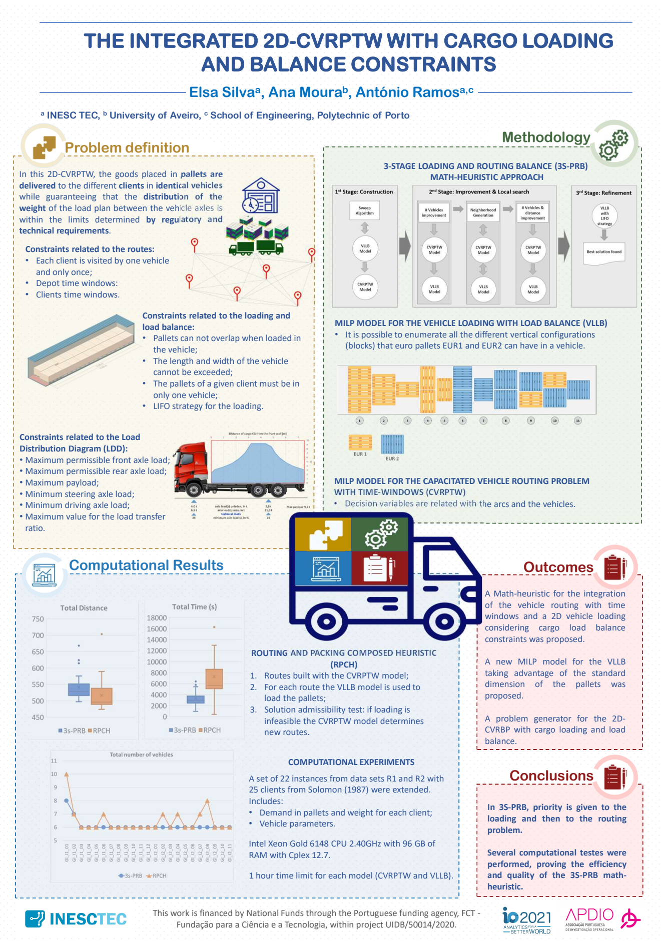
Submissão #46

The integrated 2D-CVRPTW with cargo loading and balance constraints

Elsa Silva, Ana Moura, António G. Ramos

This work integrates the capacitated vehicle routing problem (VRP) with time windows and the 2D loading problem with balance constraints. The goods placed in pallets are delivered to the different clients in identical vehicles while guaranteeing that the distribution of the weight of the load plan between the vehicle axles is within limits determined by regulatory and technical requirements. Implementing new regulatory and technical requirements for the distribution of vehicle axle weights in road freight transport places a new set of constraints on VRP. The load plan in the freight transport units has been neglected in determining the routing of vehicles, which acquires greater importance since non-compliance with the axle weight distribution legislation translates into heavy fines. A three-phase math-heuristic is proposed to generate cargo loading plans and routing sequences of a palletised cargo distribution problem. The math-heuristic gives greater importance to the loading problem, and then to the VRP. Moreover, a new MILP model for the 2D pallet loading problem with balance constraints taking advantage of the standard dimension of pallets is proposed. Extensive computational experiments were performed with well-known literature benchmark instances extended to incorporate additional features. The computational results show the effectiveness of the proposed approach.

Keywords: Vehicle Routing Problem, Vehicle Loading Problem, Load Balance, Math-heuristic



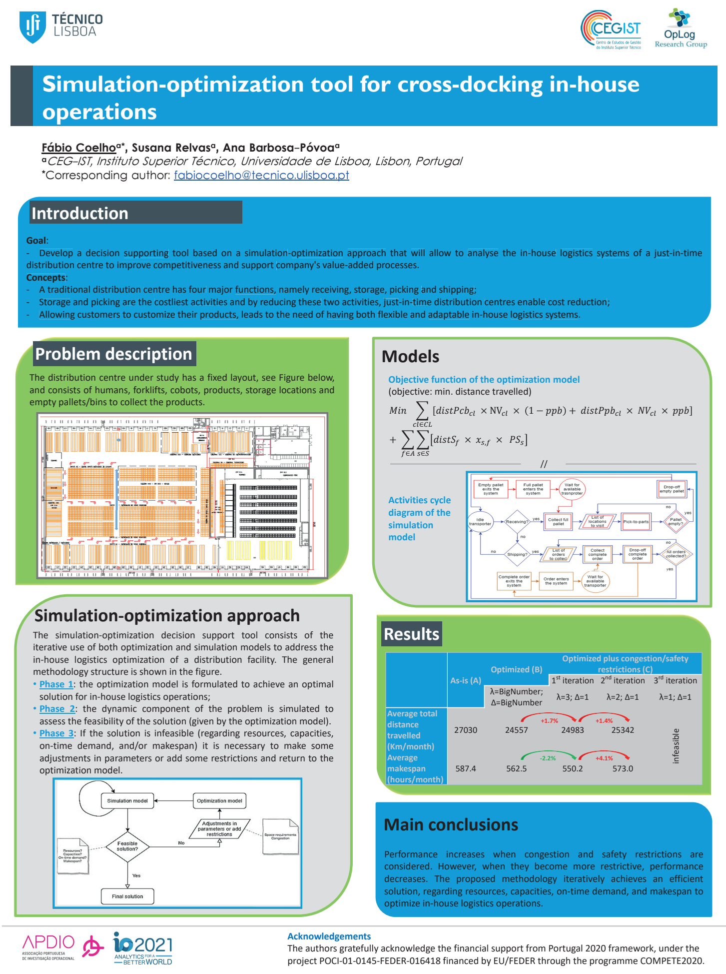
Submissão #47

Cross-docking in-house operations: a simulation-optimization approach

Fábio Coelho, Susana Relvas, Ana Barbosa-Póvoa

The need for companies to have extremely efficient and flexible distribution facilities makes in-house logistics operations complex in a just-in-time context. Thus, to reach the desired levels of efficiency for their companies, decision-makers need to be equipped with decision support tools to help them manage their in-house logistics operations. In this way, a decision support tool based on an optimization-simulation approach is here developed to explore in-house logistics operations. Several scenarios are analysed in order to study these operations with the objective of finding possible sources of congestion and identify improvements. The developed tool was applied to a real-based case of a cross-docking facility, and the results show possible improvements in the system through the optimization of in-house logistics operations.

Keywords: simulation-optimization, in-house logistics, cross-docking, warehouse



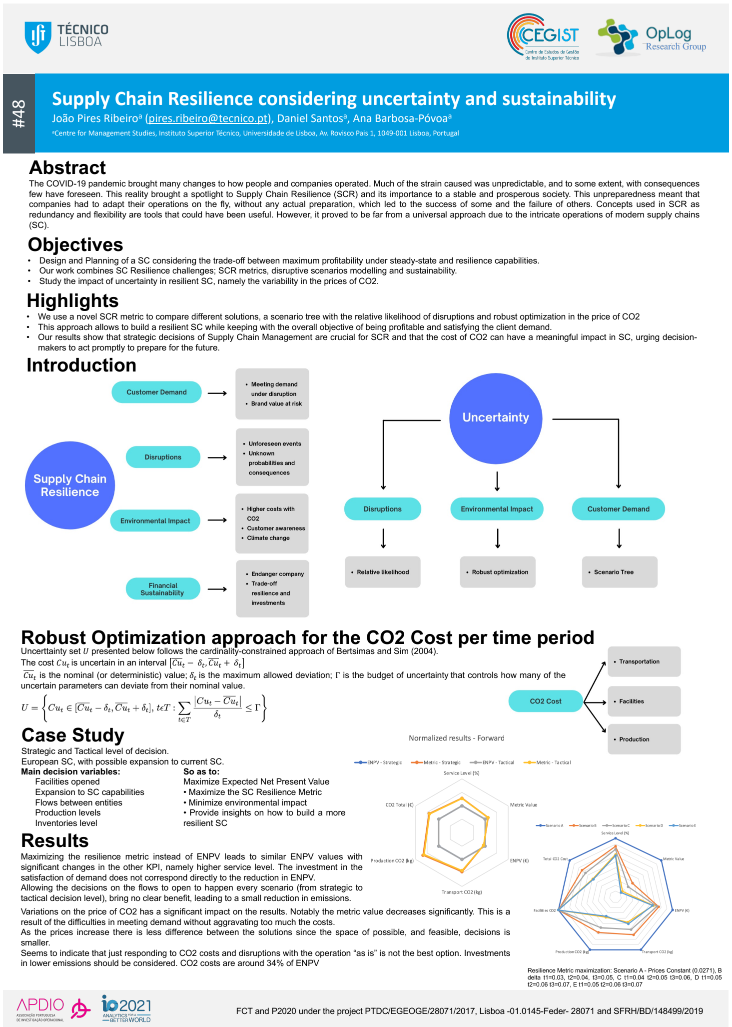
Submissão #48

Supply Chain Resilience considering uncertainty and sustainability

João Pires Ribeiro, Daniel Santos, Ana Barbosa-Póvoa

The COVID-19 pandemic brought many changes to how people and companies operated. Much of the strain caused was unpredictable, and to some extent, with consequences few have foreseen. This reality brought a spotlight to Supply Chain Resilience (SCR) and its importance to a stable and prosperous society. This unpreparedness meant that companies had to adapt their operations on the fly, without any actual preparation, which led to the success of some and the failure of others. Concepts used in SCR as redundancy and flexibility are tools that could have been useful. However, it proved to be far from a universal approach due to the intricate operations of modern supply chains (SC). Moreover, the scarcity of resources and the trade-off towards maximum profitability under steady-state conditions turns the effort of designing and planning a SC into a challenging task. Here, we present our work that combines SC Resilience challenges; SCR metrics, disruptive scenarios modelling and sustainability. We use a novel SCR metric to compare different solutions, a scenario tree with the relative likelihood of disruptions and robust optimization in the price of CO2 to prepare a SC for Resiliency while keeping with the overall objective of being profitable and satisfying the client demand. Our results show that strategic decisions of Supply Chain Management are crucial for SCR and that the cost of CO2 can have a meaningful impact in SC, urging decision-makers to act promptly to prepare for the future.

Keywords: Supply Chain Resilience, CO2, Uncertainty, Disruptions



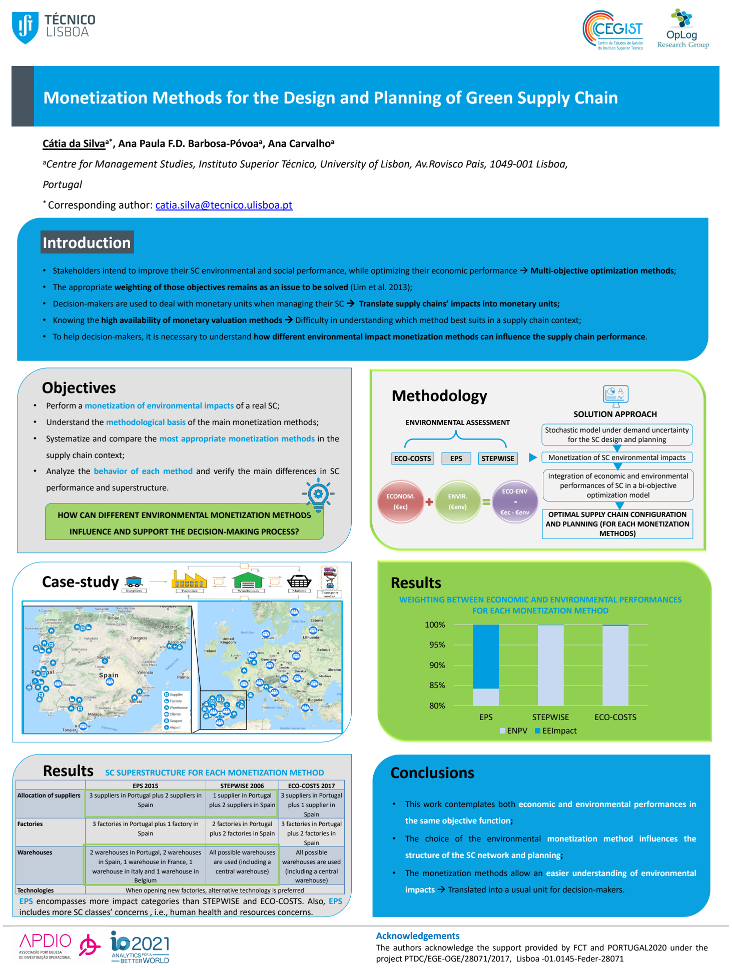
Submissão #49

Monetization Methods for the Design and Planning of Green Supply Chain

Cátia da Silva, Ana Barbosa-Póvoa, Ana Carvalho

The need to comply with environmental requirements has become a growing issue in supply chains. Nowadays it is not enough to achieve strong financial outcomes, but also to respond to environmental practices that are required for a better companies' sustainable development. Additionally, the environmental decisions are not easy to take due to the difficulties associated with its quantification and understanding by decision-makers. In this way, the quantification of the environmental impacts in a monetary unit easily understood by decision-makers can effectively simplify the decision-making process. However, there are no studies that address how different environmental impact monetization methods can influence supply chain performance. This study explores how different monetization methods may influence supply chain design and planning. To do that a mixed-integer linear programming model is developed for the design and planning of supply chain that accounts for economic and environmental goals. The three main monetization methods are characterized and used to model the environmental supply chain performance. The model is applied to a set of case studies. As main conclusion, this work contributes to understanding the behaviour of each monetization method and what are the main differences in supply chain performance, related to supply chain design and planning.

Keywords: green supply chain, monetization, design and planning, sustainability



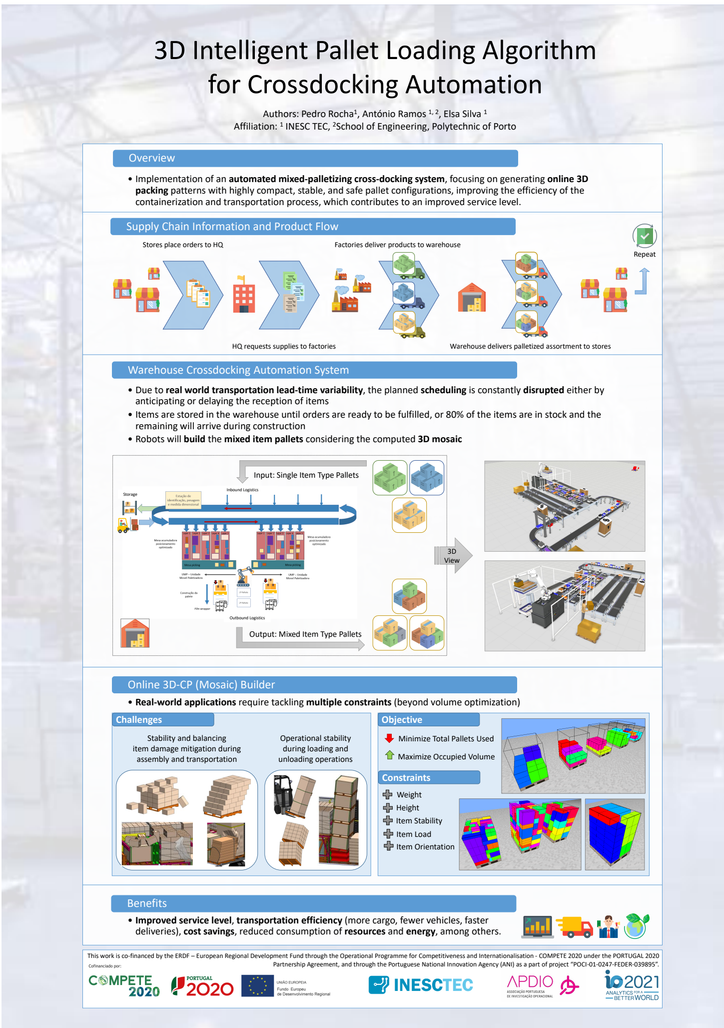
Submissão #50

3D intelligent pallet loading algorithm for crossdocking automation

Pedro Rocha, António G. Ramos, Elsa Silva

The current challenge tackles the implementation of an automated mixed-palletizing cross-docking system, focusing on generating online 3D packing patterns with highly compact, stable, and safe pallet configurations. This improves the efficiency of the containerization and transportation process, which contributes to an improved service level. In the literature, this problem is described as 3D-CLP and is common in supply chains and industries where cargo transportation inside a container is required. Most research related to 3D-CLP focuses on volume optimization, while real-world applications require additional constraints to be tackled, such as stability and balancing for item damage mitigation during assembly and transportation, and also operational safety during loading and unloading operations. Additionally, there is a lack of research considering real-time (online) packing of the items (especially when no information exists about their arrival order, time and sequence, and palletization need to be done as soon as they are available). This problem is created by real world transportation lead-time variability, which disrupts the planned scheduling by delaying or anticipating the reception of the items, causing a decrease in the service level (among other metrics). Due to the complexity of this problem, the most viable approach consists of the use of heuristics.

Keywords: 3D Container Loading Problems, Online Palletization, Cutting and Packing problems



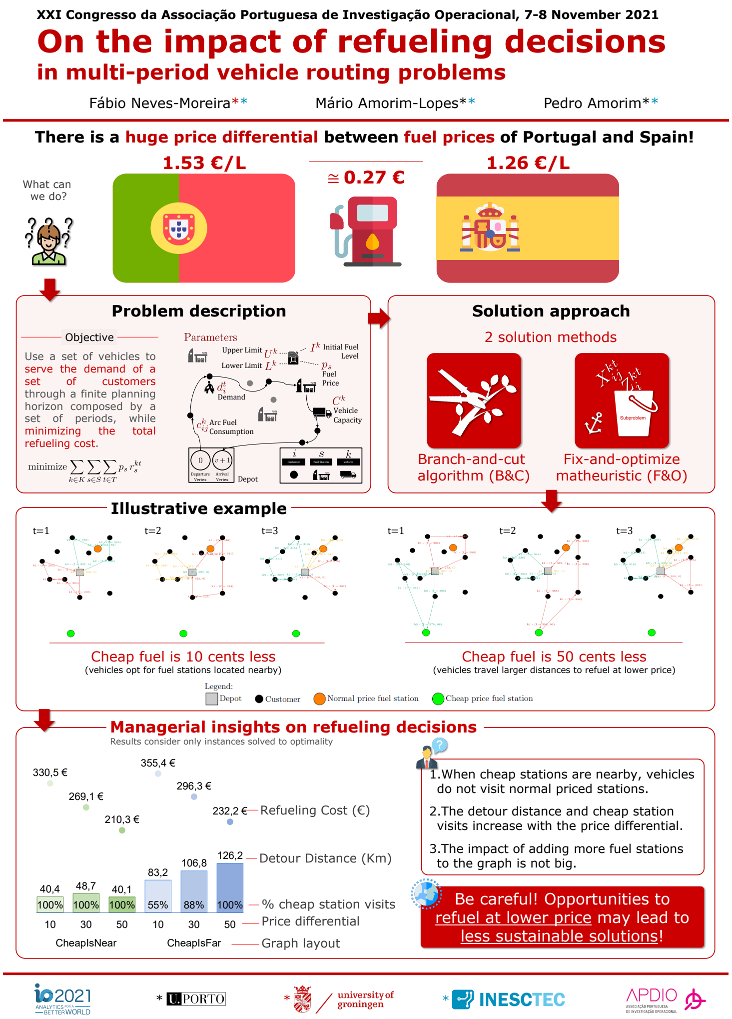
Submissão #51

The multi-period vehicle routing problem with refueling decisions

Fábio Neves-Moreira, Mário Amorim-Lopes, Pedro Amorim

Surprisingly, most vehicle routing approaches disregard the need to refuel the fleet during the considered planning horizon. However, refueling operations may impact vehicle routes, affecting travelled distance and transportation cost. In this work, our main goal is to provide managerial insights on the impact of considering refueling operations in multi-period vehicle routing problems. To efficiently find solutions, we propose a novel mathematical formulation, which is solved by both a branch-and-cut algorithm and a matheuristic approach. The computational experiments on a new set of randomly generated instances demonstrate that the branch-and-cut converges to the optimal solution in single-vehicle instances and that the matheuristic achieves an average optimality gap that is below 7% for the whole set of instances. Furthermore, we perform a sensitivity analysis on several fuel-related parameters. Results indicate that, to minimize costs, the percentage of detour distance may increase up to 6 percentage points when fuel stations with lower prices are further from the depot. The importance of considering a multi-period horizon in this vehicle routing problem is also analysed. For practice, these insights imply that current policies disregarding the location and/or price of fuel stations along with "myopic"planning horizons may lead to sub-optimal decisions.

Keywords: Transportation, Vehicle routing, Refueling decisions, Branch-and-cut, Matheuristic, Managerial insights



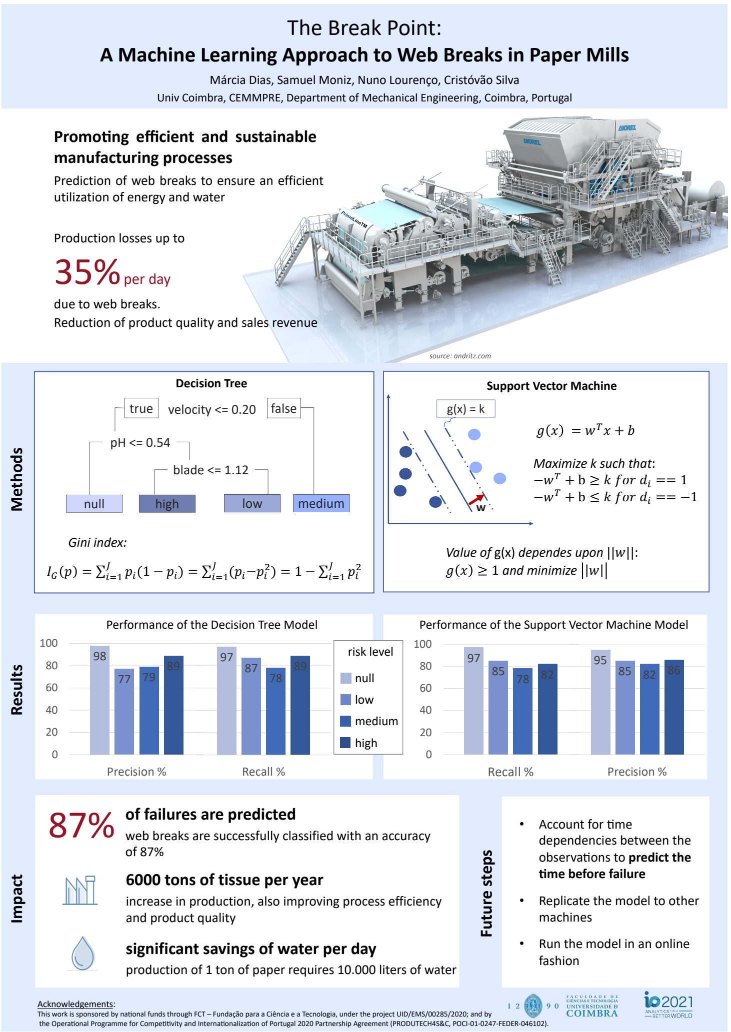
Submissão #52

Identifying and predicting web breaks in a tissue machine: a machine learning approach

Marcia Dias, Samuel Moniz, Nuno Lourenço, Cristóvão Silva

Web breaks are a significant operational challenge of the paper industry, which affect process efficiency and product quality. This work aims to develop and validate a machine learning approach to predict the risk of web breaks in tissue machines, in real-time. Firstly, we select a reduced set of variables to avoid data unavailability and sensor errors. Secondly, we use data segmentation to define web break trajectories and risk levels, which helps in identifying failure patterns. Lastly, we develop a prediction model to find patterns during the regular operation of the machine. To validate the approach, we applied it to a large-scale industrial problem. Results show that the model effectively predicts web breaks with an accuracy of 87%, reducing production losses by up to 6000 tons of paper per year. These results corroborate the contributions of the proposed approach, namely: i) the developed variable selection scheme can effectively translate a very complex manufacturing system into a reduced set of variables; ii) the procedure uses production data to support effective decisions that leverage the productivity of recent and technologically advanced tissue machines; and iii) the comprehensive data-driven procedure copes with the increasing pressure to increase the production efficiency of continuous production environments.

Keywords: decision trees, machine learning, paper industry, prediction model, web breaks



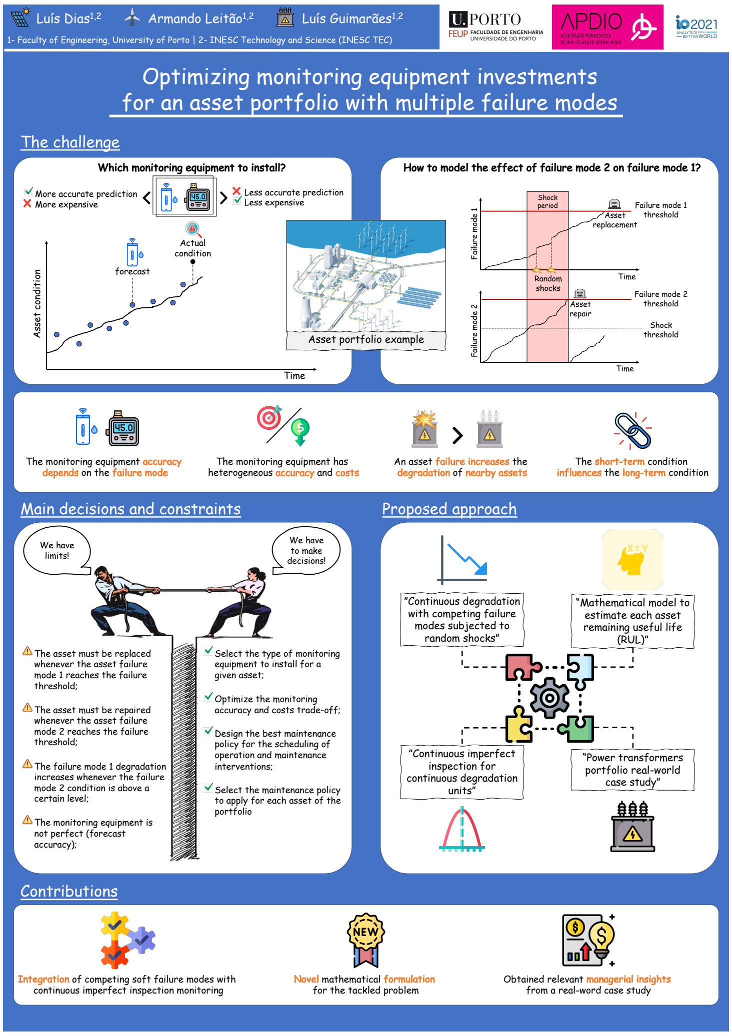
Submissão #53

Optimizing monitoring equipment investment for an asset portfolio with multiple-failure modes

Luis Dias, Armando Leitão, Luis Guimarães

In many industries, asset portfolio condition degradation is stochastic and subjected to multiple failure modes, negatively impacting asset availability and longevity. To minimize this impact, recent technological advances in monitoring technology may foster a reduction in degradation uncertainty and prevent asset failures. Notwithstanding, the extra effort regarding the investment plan on this type of equipment must be carefully planned. Since investing in monitoring equipment requires substantial capital due to the system size, DMs must define which and when a given asset monitoring technology will be installed. Hence, not every asset may have the same monitoring technology and, consequently, the same degradation uncertainty. Bearing this in mind, we propose a methodology to determine the investments in the installation of monitoring equipment for an asset portfolio with multiple failure modes and maintenance budget constraints. The goal is to optimize the cost of reducing the asset degradation uncertainty and maintenance costs without exceeding the available budget. We formulate the problem as a stochastic optimization problem to capture the uncertainty in the assets' condition. The approach is validated in a case study in the electricity distribution in which a system operator must manage a portfolio of power transformers operating under different operational conditions.

Keywords: Multi-unit system, Predictive maintenance, Stochastic optimization, Mixed-integer models, Multiple failures modes



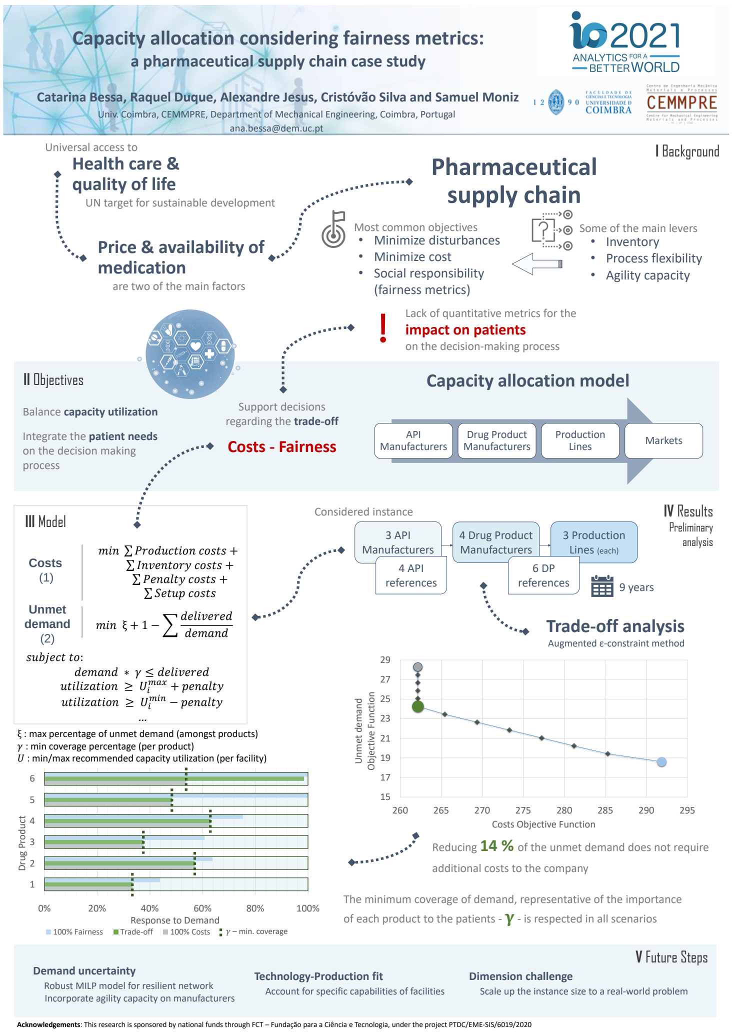
Submissão #54

Capacity allocation considering fairness metrics: a Pharmaceutical Supply Chain case study

Catarina Bessa, Raquel Duque, Alexandre Jesus, Cristóvão Silva, Samuel Moniz

Most drug shortages are related to Pharmaceutical Supply Chain (PSC) vulnerabilities that occur in several production stages. This work seeks to improve the efficiency and sustainability of global pharmaceutical networks by proposing a capacity allocation model that includes fairness metrics to balance the response to patient needs with economic goals. A four-tier supply chain deterministic model, inspired by the literature, is developed to include quantitative metrics that quantify the patient's point of view. To ensure the validity of the proposed approach, the model was verified with real data collected from a leading pharmaceutical company. Furthermore, the results give important insights on optimal product allocation, inventory, and reserved capacity within the supply chain.

Keywords: Capacity Allocation, Mathematical Programming, Supply Chain Management, Fairness Metrics



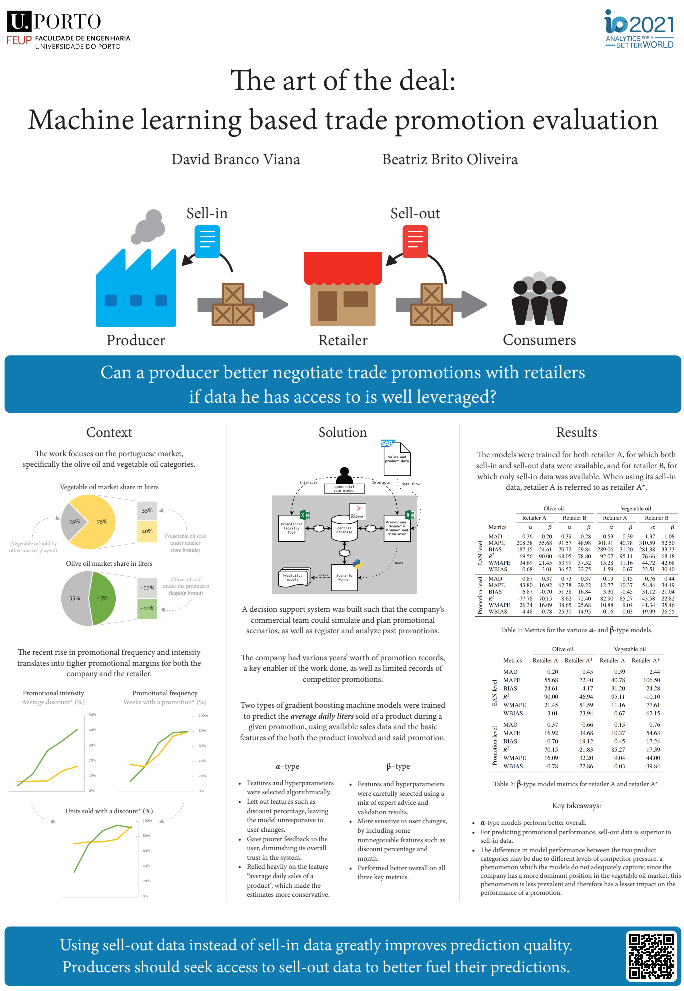
Submissão #55

The art of the deal: Machine learning based trade promotion evaluation

David Viana, Beatriz Brito Oliveira

Trade promotions are a complex marketing strategy to drive up sales, involving retailer and consumer dynamics. Furthermore, these events are time-sensitive, influenced by past promotions and both competitor initiatives and responses. In the Consumer Packaged Goods (CPG) sector, the proportion of price-promoted sales to regular-priced sales has increased to a very significant level. Given their relevance to the manufacturer's revenue, proper promotional planning is crucial. In this context, this work proposes a decision support system capable of evaluating a hypothetical trade promotion's success, based on historic data, to be used for the promotional planning process of two key product lines of a CPG manufacturer. At the core of this decision support system, a predictive model, based on machine learning algorithms, will leverage both time series data and predictor variables, in order to better predict future promotional performance. This work pulls from many different branches of knowledge namely, Marketing, Economics, Forecasting, Machine learning and Data mining, areas which are briefly introduced.

Keywords: Forecasting, Promotion planning, Retail



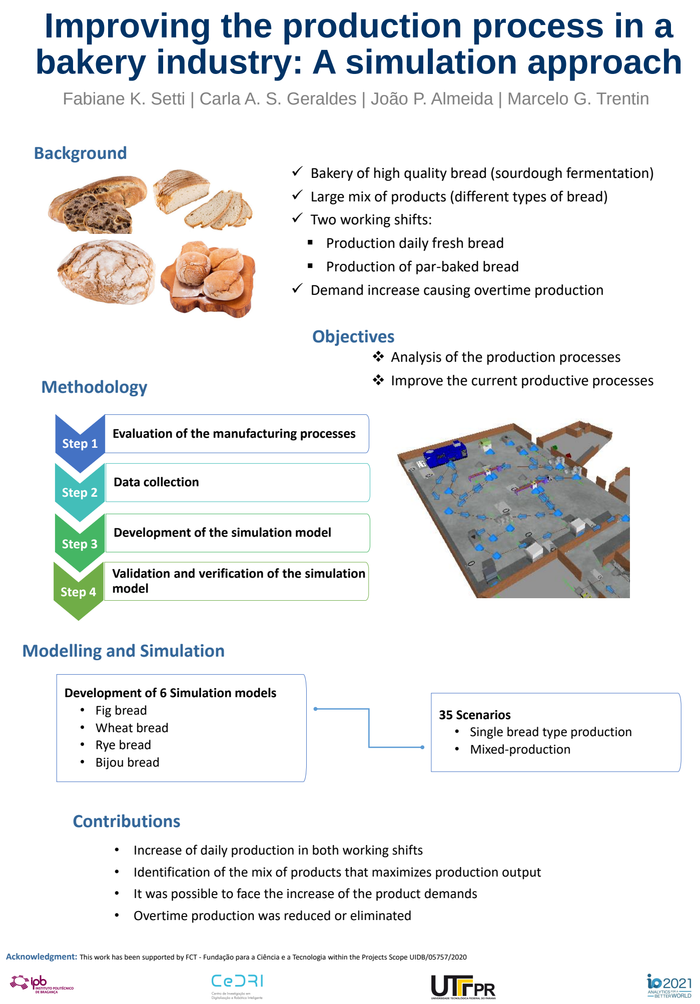
Submissão #56

Improving the production process in a bakery industry: a simulation approach

Fabiane K. Setti, Carla A. S. Geraldes, João P. Almeida, Marcelo G. Trentin

The present study brings forward a simulation-based study of the production process of a Portuguese company that produces a wide range of bread. The main objective of this study was to analyse the different production processes of the company, and to propose further improvements to these, through the use of discrete event simulation. A relevant set of data was collected and four productive processes were chosen to be modelled using the Simulation Modelling based on Intelligent Objects software (Simio). The analysis of the developed models identified the need for improvements and different scenarios were created to this purpose. Among the obtained results, the creation of different mixed production scenarios allowed the maximisation of the production level while maintaining the current existing resources. The results of this work can be implemented in the company to increase production level without increasing costs since they do not involve the purchase of new equipment. In conclusion, this study highlights the ability of the simulation technique to analyse manufacturing processes throughout the creation of different scenarios providing insights on the production process optimising companies' productive performance.

Keywords: manufacturing process, optimisation, discrete simulation



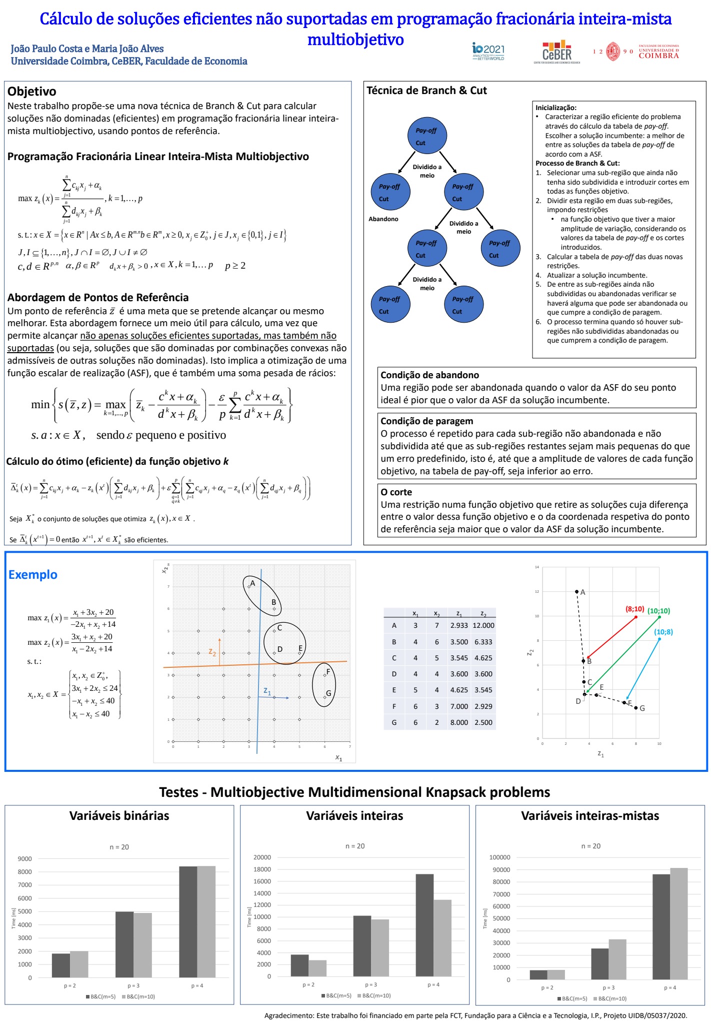
Submissão #57

Cálculo de soluções eficientes não suportadas em programação fracionária inteira-mista multiobjetivo

João Paulo Costa, Maria João Alves

Neste trabalho propõe-se uma nova técnica de Branch Cut para calcular soluções não dominadas (eficientes) em programação fracionária linear inteira-mista multiobjectivo, usando pontos de referência. As abordagens de pontos de referência fornecem um meio útil para este cálculo, uma vez que permitem alcançar não apenas soluções eficientes suportadas, mas também não suportadas (ou seja, soluções que são dominadas por combinações convexas não admissíveis de outras soluções não dominadas). Um ponto de referência é uma meta que se pretende alcançar ou mesmo melhorar. Isto implica a otimização de uma função escalar de realização (ASF). A ASF utilizada permite determinar qualquer solução não dominada através da alteração do ponto de referência, garantindo também que apenas se obtêm soluções não dominadas. Infelizmente, o problema transforma-se numa soma de rácios, que é conhecido como um dos problemas não lineares mais difíceis de resolver. Propõe-se, nesta comunicação, uma nova técnica de Branch Cut para este problema. Já existem algoritmos que podem resolver este tipo de problema na prática, desde que não haja variáveis inteiras. Apresentam-se também vários testes computacionais para avaliar o desempenho da técnica.

Palavras chave: Programação fracionária inteira-mista multiobjetivo, Branch Cut, Soluções eficientes não suportadas



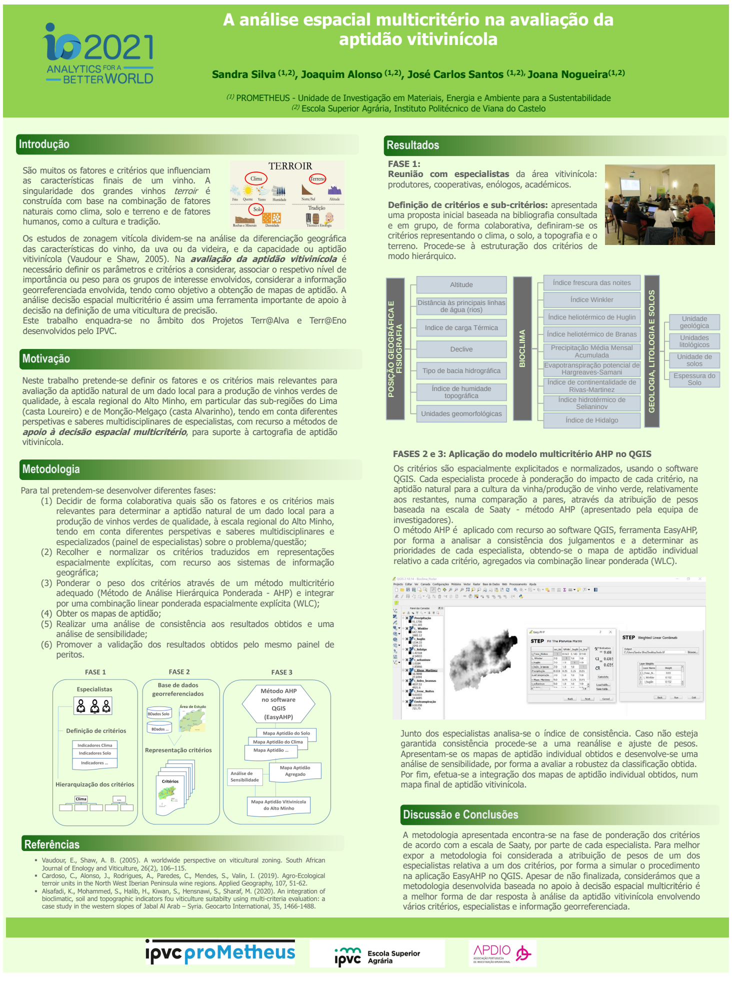
Submissão #58

A análise espacial multicritério na avaliação da aptidão vitivinícola

Sandra Silva, Joaquim Alonso, José Santos, Joana Nogueira

São muitos os fatores e critérios que influenciam as características finais de um vinho. A singularidade dos grandes vinhos terroir é construída com base na combinação de clima, solo e terreno. O conhecimento da zonagem agro-ecológica e aptidão natural, cultural e económica vitivinícola para a definição e gestão do terroir são condições necessárias de suporte à melhoria do planeamento, dinamização e sustentabilidade dos territórios e unidades de produção vitivinícolas. A avaliação espacial multicritério é uma ferramenta importante de apoio à decisão na definição de uma viticultura de precisão, mais especificamente na definição e análise dos fatores e critérios mais relevantes para avaliação da aptidão natural de um dado local para a produção de vinhos, considerando diferentes perspetivas e saberes multidisciplinares de especialistas.

Palavras chave: Terroir, Apoio à decisão multicritério, Sistemas de Informação Geográfica



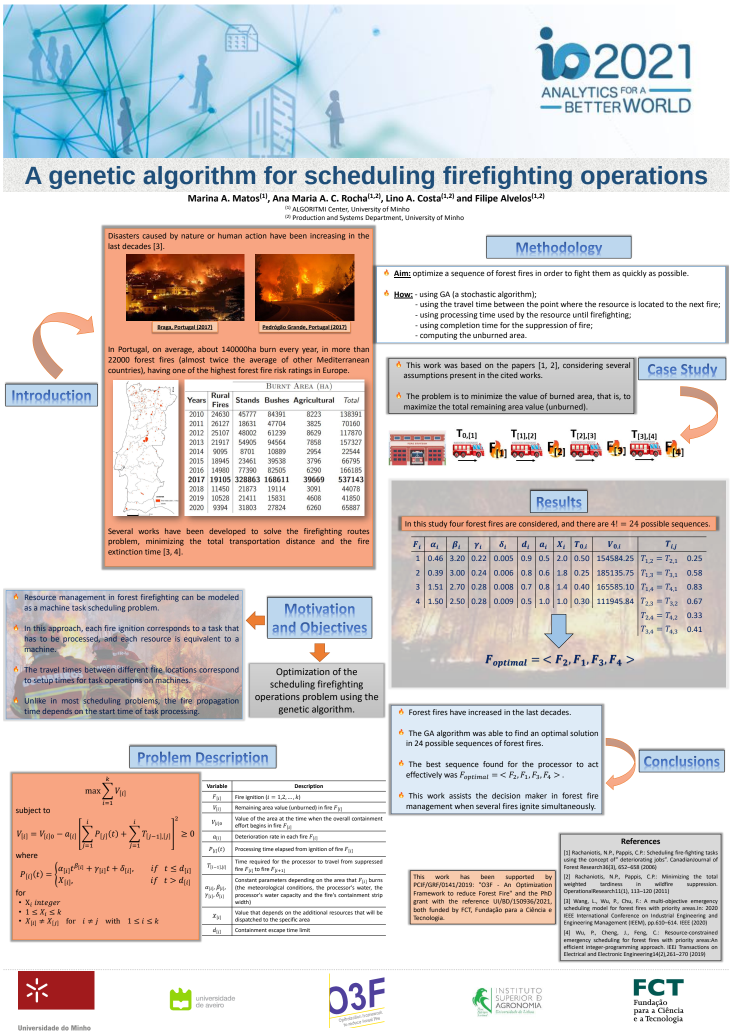
Submissão #59

Um algoritmo genético para o escalonamento de operações de combate a incêndios

Marina Matos, Ana Rocha, Filipe Alvelos, Lino Costa

A gestão de recursos no combate a incêndios florestais pode ser modelada como um problema de escalonamento de tarefas em máquinas. Nessa abordagem, cada incêndio, ou cada parte de um incêndio, corresponde a uma tarefa que tem de ser processada e cada recurso corresponde a uma máquina. Os tempos de viagem entre diferentes incêndios correspondem a tempos de preparação das operações das tarefas nas máquinas. Um aspeto essencial é que, ao contrário do que acontece na generalidade dos problemas de escalonamento, o tempo de processamento depende do tempo de início do processamento da tarefa. Neste trabalho desenvolve-se um algoritmo genético para obter soluções para este problema. Este trabalho foi realizado no âmbito de PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire"e pela bolsa de doutoramento com a referência UI/BD/150936/2021, ambos financiados pela FCT, Fundação para a Ciência e Tecnologia.

Palavras chave: Incêndios Florestais, Escalonamento, Algoritmo Genético



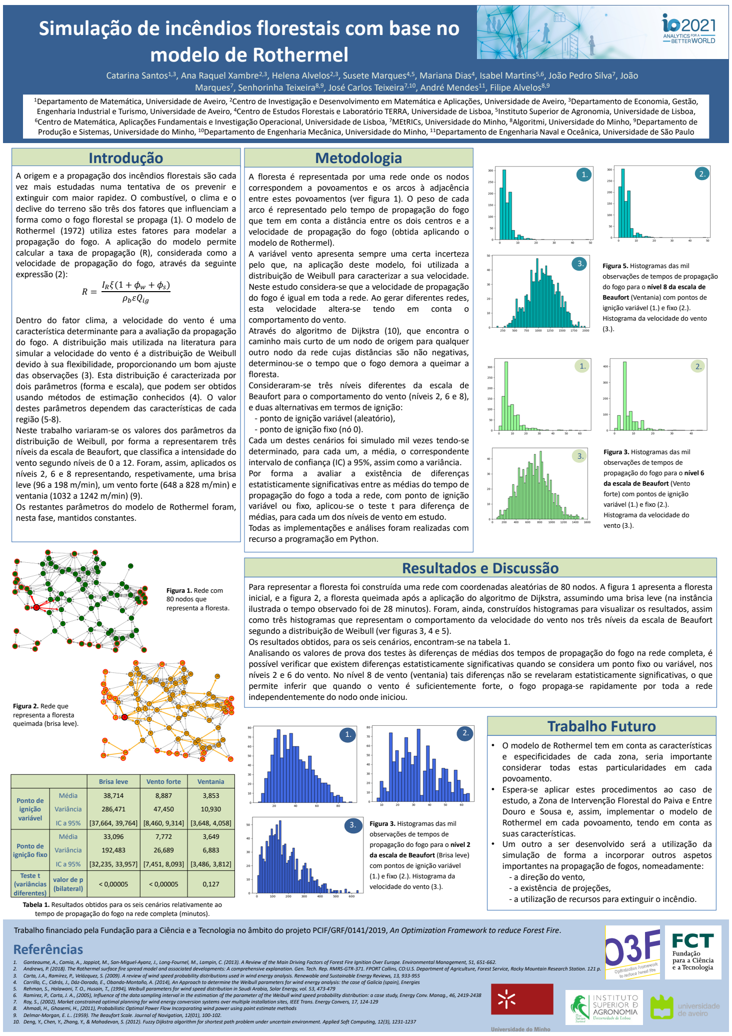
Submissão #60

Simulação de incêndios florestais com base no modelo de Rothermel

Catarina Santos, Ana Raquel Xambre, Helena Alvelos, Susete Marques, Mariana Dias, Isabel Martins, João Pedro Silva, João Marques, Senhorinha Teixeira, José Carlos Teixeira, André Mendes, Filipe Alvelos

A forma como o fogo florestal se propaga depende, principalmente, de três factores: combustível (que pode ser caracterizado pela humidade, poder calorífico e carga), clima (nomeadamente a velocidade e a orientação do vento) e o declive do terreno. A incerteza do comportamento ao longo do tempo e do espaço destes factores dificulta a modelação da propagação do fogo. Neste trabalho modela-se essa incerteza através de simulação. A paisagem é representada por uma rede em que os nodos correspondem a células e os arcos à adjacência entre células. Após serem estimadas a velocidade de propagação do fogo (entre células adjacentes) com base na variação de parâmetros do modelo de Rothermel, que permite estimar a velocidade de propagação do fogo de acordo com os factores referidos, utiliza-se a simulação para caracterizar a propagação do fogo. Este trabalho foi realizado no âmbito do projeto PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire"financiado pela FCT, Fundacão para a Ciência e Tecnologia.

Palavras chave: Fogos florestais, Simulação, Modelação de incerteza



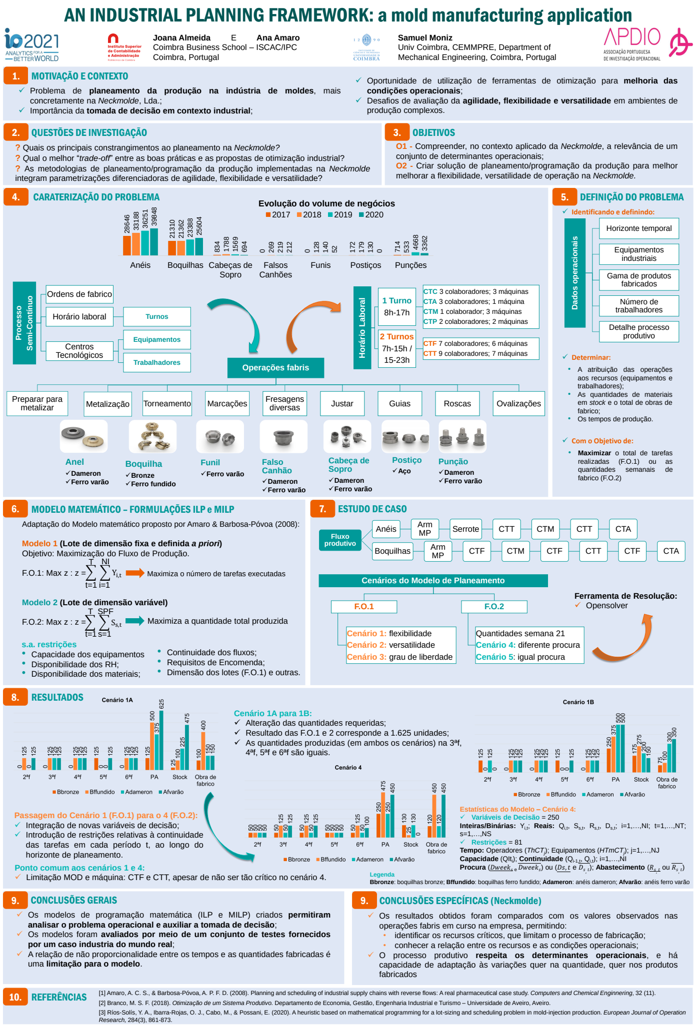
Submissão #61

An Industrial Planning Framework: a mold manufacturing application

Joana Almeida, Ana Amaro, Samuel Moniz

This work is focused on the production planning problem of the mold industry and aims at providing a better understanding of how to achieve operational determinants, such as agility, flexibility, and versatility in complex production environments. The study is concerned with the development of a representation framework for supporting the proposal of integer and mixed-integer linear programming mathematical formulations. The developed models were validated through a set of tests provided by a real-world industrial case. Different planning horizons and operational conditions such as fixed and variable batch dimension, product changeover, minimum and maximum delivery amounts were analyzed. The results obtained were compared with the values observed at the manufacturing operations in progress at the company. These allowed us to identify the critical resources that are limiting the manufacturing process and learn about their relationship with the operational conditions. Also, different model parameterizations proved that a greater amount of production does not mandatory results in a longer production time. Accordingly, the advantage and usefulness of the developed models were demonstrated at the organization on a practical basis.

Keywords: Production Planning, Mathematical Programming, Mold Industry, Flexibility



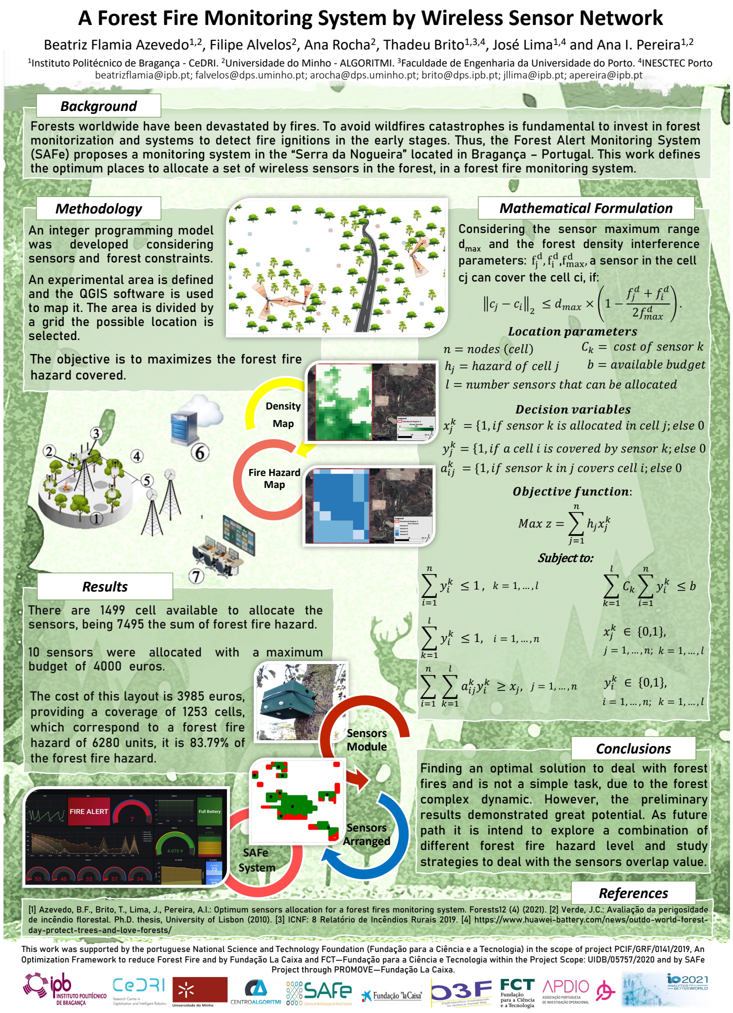
Submissão #62

A Forest Fire Monitoring System by Wireless Sensor Network

Beatriz Flamia Azevedo, Filipe Alvelos, Ana Rocha, Thadeu Brito, José Lima, Ana Isabel Pereira

Forests worldwide have been devastated by fires. It is known to avoid wildfires catastrophes is fundamental to invest in forest monitorization and systems to detect fire ignitions in the early stages. For this, the development of innovative operations is necessary, such as a forest fire monitoring system based on wireless sensors network. This work concentrates efforts on defining strategic places to allocate a set of sensors inside the forest environment, in order to constitute a forest fire monitoring system. For this, an integer programming model was developed, in which some sensors, with different technical specifications (cost, range distance) are considered and the forest characteristic (forest density and forest fire hazard) is taken into account to define the optimum position for each sensor. The objective is to maximise the coverage provided by the sensors in the area with higher forest fire hazard, considering the sensors and the environmental constraints. The proposed method demonstrated that the methodology can be useful to decision support in the task of spreading sensors into the forest, since it was capable to define optimal points to allocate the sensors in large scale instances. Este trabalho é apoiado pela FCT - Fundação para a Ciência e Tecnologia - no âmbito do projeto da unidade de ID: UIDB/00319/2020.

Keywords: Forest fire, Wireless sensor, Integer Optimization



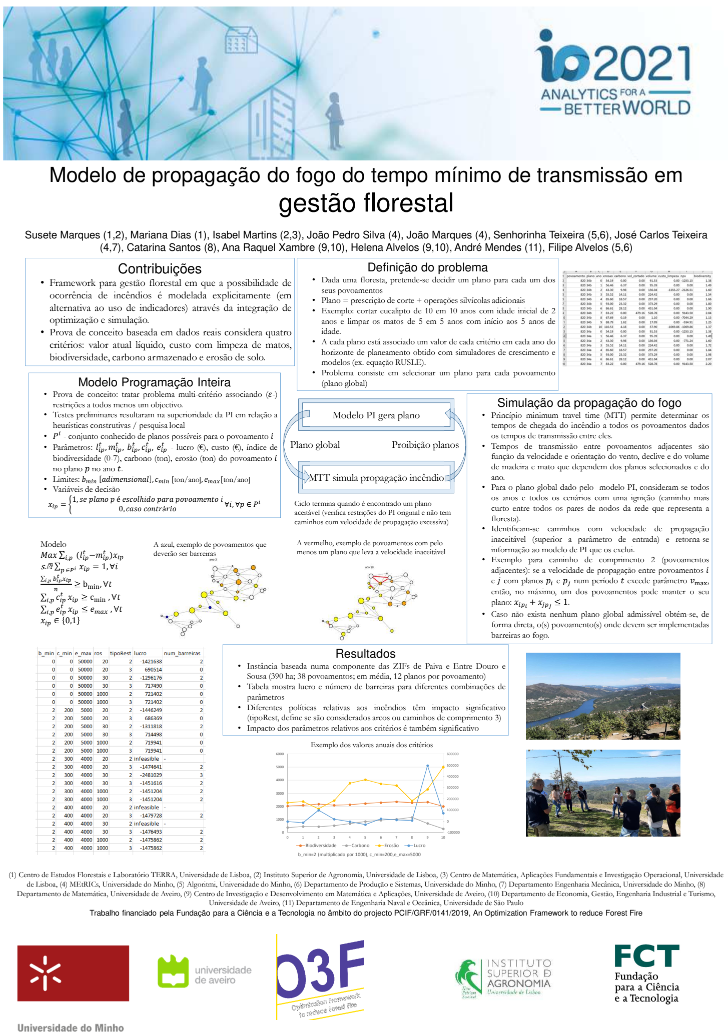
Submissão #63

Modelo de propagação do fogo do tempo mínimo de transmissão em gestão florestal

Susete Marques, Mariana Dias, Isabel Martins, João Pedro Silva, João Marques, Senhorinha Teixeira, José Carlos Teixeira, Catarina Santos, Ana Raquel Xambre, Helena Alvelos, André Mendes, Filipe Alvelos

Neste trabalho propõe-se a utilização do modelo de propagação de fogo de tempo mínimo de transmissão em gestão florestal. Parte-se da usual representação da paisagem como um conjunto de povoamentos. Para cada povoamento, pretende-se seleccionar uma de entre um conjunto de acções possíveis (i.e. limpeza, corte raso, desbaste, corte de madeira, â?¦) que definem um plano. Cada plano resulta em diferentes níveis de satisfação de cada um de um conjunto de critérios (e.g. produção de madeira, sequestro de carbono e conservação da biodiversidade). Em vez de modelar a potencial ocorrência de incêndios como um critério (e.g. soma ponderada dos índices de vulnerabilidade dos povoamentos), usam-se cenários (cada um caracterizado por um local de ignição e condições meteorológicas) para excluir planos catastróficos e seleccionar planos aceitáveis. Dado o número de planos ser intratável, usa-se um modulo gerador de planos (com heurísticas construtivas e de pesquisa local) e um módulo avaliador que usa o modelo de propagação do fogo do tempo mínimo de transmissão para avaliar os planos em diferentes cenários. Este trabalho foi realizado no âmbito PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire, financiado pela FCT, Fundação para a Ciência e Tecnologia.

Palavras chave: Propagação do fogo, Heuristicas, Optimização, Gestão florestal



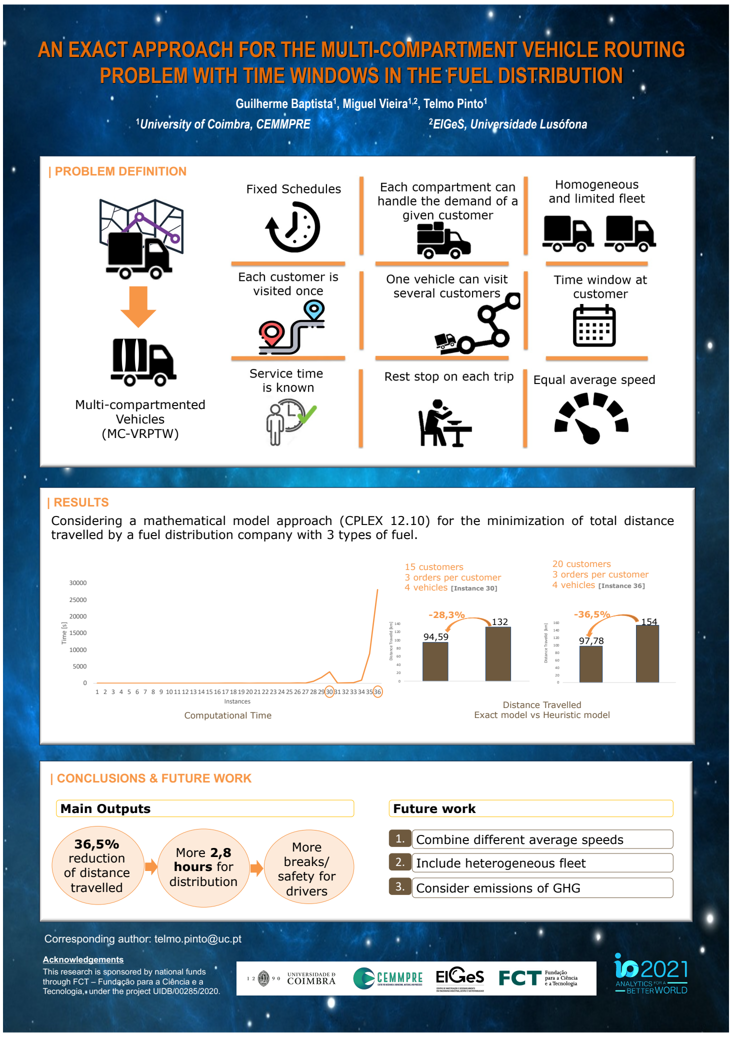
Submissão #64

An Exact Approach for the Multi-Compartment Vehicle Routing Problem with Time Windows in the Fuel Distribution

Guilherme Baptista, Miguel Vieira, Telmo Pinto

Over the years, several authors have widely studied the Capacitated Vehicle Routing Problem, considering different extensions for this problem. An example of these extensions is the Multi-Compartment Vehicle Routing Problem. However, few works from the literature tackle this problem using exact approaches, even more when time windows are explicitly considered. In this sense, we present a mathematical model for the Multi-Compartment Vehicle Routing Problem with Time-windows (MC-VRPTW), taking a fuel retailer company as a case study. Additional constraints that are not commonly addressed in the literature but usually arising from real-world contexts are also considered, such as rest times for the drivers, working time limits, and the maximum duration for each route. Three types of fuels are delivered to a set of customers using a limited homogeneous fleet. Therefore, for each vehicle, it is necessary to determine the route to carry out the deliveries, the instant of time that each customer is visited, the instant time of each break, and the load of each compartment. The efficiency of this exact approach is assessed through a set of computational experiments and by measuring different indicators. Finally, additional tests were performed in real instances from the literature to evaluate the performance of the model.

Keywords: Multi-Compartment Vehicle Routing Problem, Fuel distribution, Mathematical Programming Models



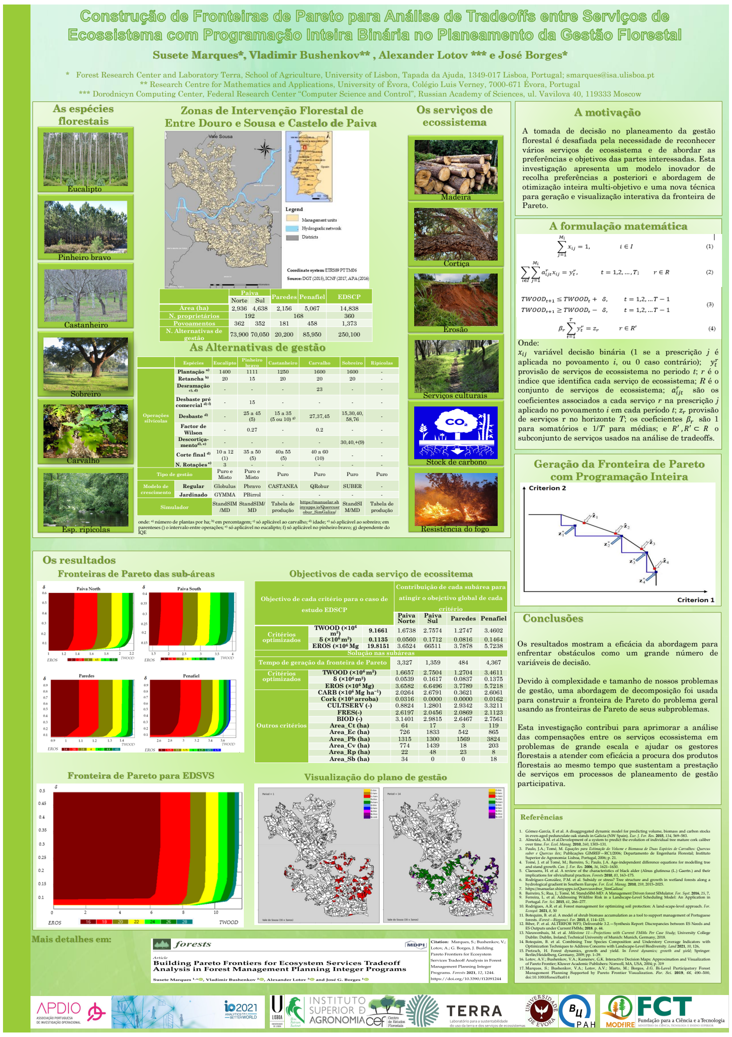
Submissão #65

Construção de Fronteiras de Pareto para Análise de Tradeoff entre Serviços de Ecossistema com Programação Inteira Binária no Planeamento da Gestão Florestal

Susete Marques, Vladimir Bushenkov, Alexander Lotov, José G. Borges

A tomada de decisão no planeamento da gestão florestal é desafiada pela necessidade de reconhecer vários serviços de ecossistema e de abordar as preferências e objetivos das partes interessadas. Esta investigação apresenta um modelo inovador de recolha preferências a posteriori e abordagem de otimização inteira multi-objetivo e uma nova técnica para geração e visualização interativa da fronteira de Pareto. Devido à complexidade e tamanho de nossos problemas de gestão, uma abordagem de decomposição foi usada para construir a fronteira de Pareto do problema geral usando as fronteiras de Pareto de seus subproblemas. Esta investigação contribui para aprimorar a análise das compensações entre os serviços ecossistema em problemas de grande escala e ajudar os gestores florestais a atender com eficácia a procura dos produtos florestais ao mesmo tempo que sustentam a prestação de serviços em processos de planeamento de gestão participativa.

Palavras chave: Gestão Florestal, Análise Multicritério, Fronteiras de Pareto, Programação Inteira



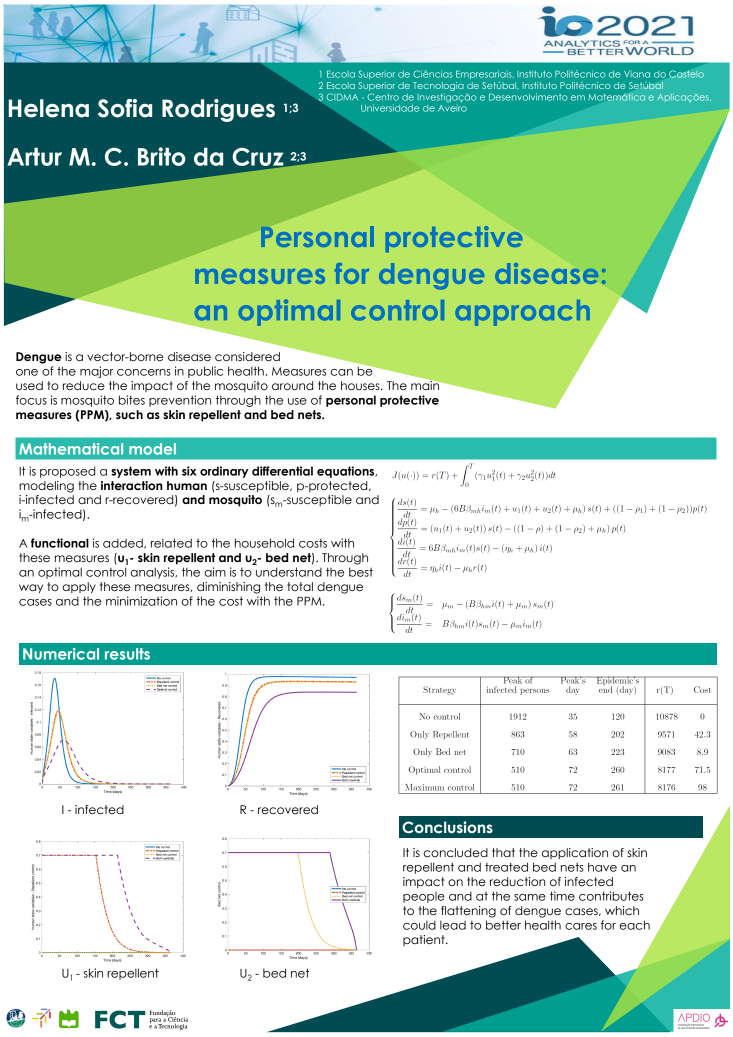
Submissão #66

Personal protective measures for dengue disease: an optimal control approach

Helena Sofia Rodrigues, Artur M. C. Brito da Cruz

Dengue is a vector borne disease, resulting from the duality mosquito-human. Besides the global measures that the health authorities provide to fight this major concern of public health, all individuals could adopt protective measures to reduce the risk of infection. These strategies could be the removal of mosquito breeding sites or the adoption of protective measures to reduce the mosquito bites. The main focus is to study the influence of using personal protective measures (PPM), such as skin repellent, bed nets or clothes treated with mosquito repellent, on the spreading of the disease. An optimal control approach is used to understand the impact in the disease when these measures are added.

Keywords: dengue, personal protection, household costs, optimal control, skin repellent, bed net



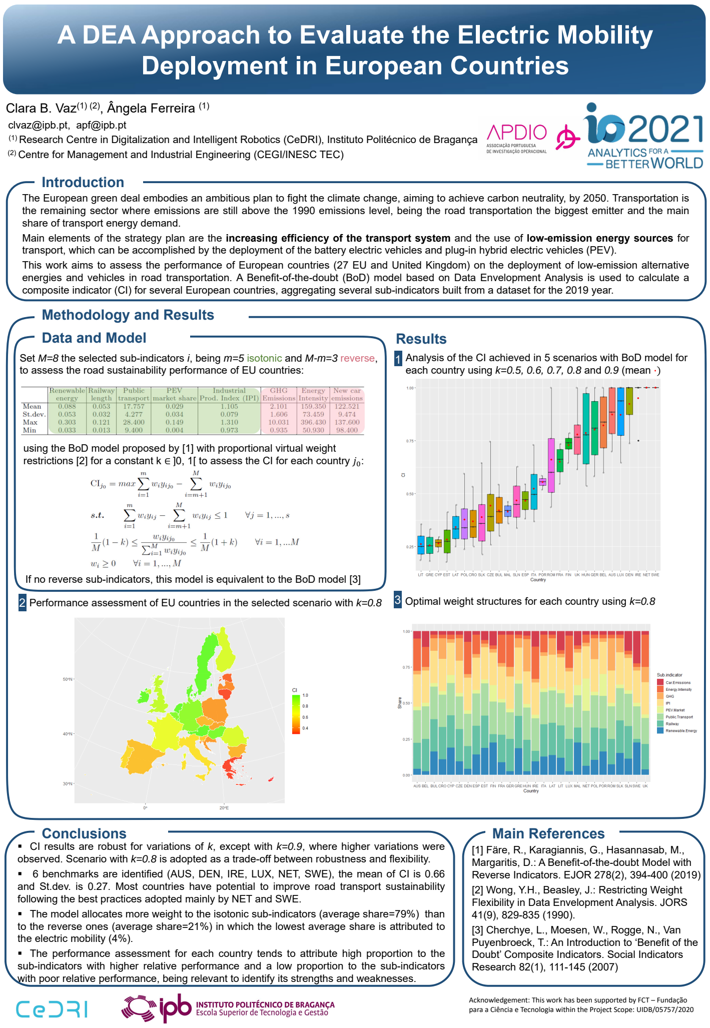
Submissão #67

A DEA Approach to Evaluate the Electric Mobility Deployment in European Countries

Clara B. Vaz, ângela P. Ferreira

The European green deal embodies an ambitious plan to fight the climate change, aiming to achieve carbon neutrality, by 2050. Transportation is the remaining sector where emissions are still above the 1990 emissions level, being the road transportation the biggest emitter and the main share of transport energy demand. Main elements of the strategy are the increasing efficiency of the transport system and the use of low-emission energy sources for transport, which can be accomplished by the deployment of the electric mobility. This work aims to assess the performance of European countries on the deployment of low-emission alternative energies and vehicles in road transportation. In order to achieve this aim, a model based on Data Envelopment Analysis (DEA) is used to calculate a composite indicator for several European countries, that aggregates several sub-indicators built from a dataset for the 2019 year. Results obtained indicate that most European countries have potential to improve their practices towards on better road transport sustainability, by emulating the best practices observed on the benchmarks. Additionally, the relative strengths and weaknesses of each country in terms of road sustainability are further explored.

Keywords: DEA, Performance, Electric mobility



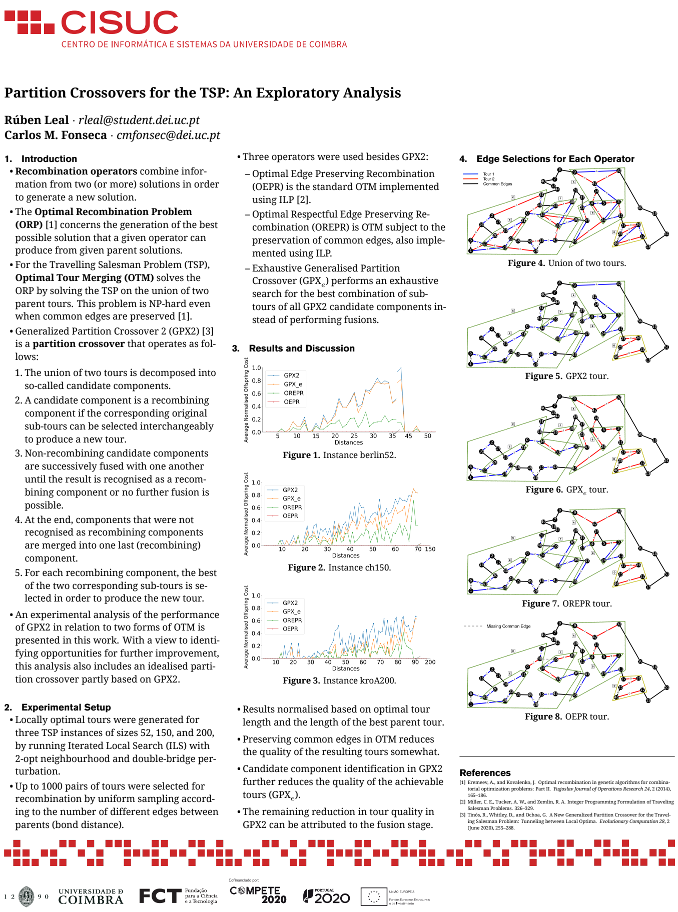
Submissão #68

An Exploratory Analysis of Partition Crossovers for the Travelling Salesman Problem

Rúben Leal, Carlos M. Fonseca

Recombination operators are crucial search operators for the performance of evolutionary algorithms and other meta-heuristics for combinatorial optimisation, whereby new, offspring solutions are generated by combining information from two (or more) parent solutions in some way. The Optimal Recombination Problem (ORP) concerns the generation of the best possible solution that a given recombination operator can produce from given parent solutions. For the Travelling Salesman Problem (TSP), the set of reachable offspring solutions is often restricted to the set of tours containing only edges present in the parents. Optimal tour merging amounts to solving the TSP on the union of the two parent solutions, which is known to be NP-hard even when common edges are preserved [1]. Partition crossovers are deterministic recombination operators that approach the ORP by decomposing parent solutions into components and exchanging them to generate valid, high-quality offspring. One such operator for the TSP is known as Generalised Partition Crossover 2 (GPX2) [2]. Since GPX2 runs in polynomial time, it is necessarily suboptimal. We present an experimental analysis of the performance of this operator in comparison to optimal tour merging, with and without enforcing preservation of common edges, and to other more restricted forms of the ORP, with a view to identifying opportunities for further improving GPX2.
References: [1] Anton Eremeev and Julia Kovalenko. "Optimal Recombination in Genetic Algorithms for Combinatorial Optimization Problems: Part II". In: Yugoslav Journal of Operations Research 24.2 (2014), pp. 165-186. doi: 10.2298/YJOR131030041E; [2] Renato Tinós, Darrell Whitley, and Gabriela Ochoa. "A New Generalized Partition Crossover for the Traveling Salesman Problem: Tunneling between Local Optima". In: Evolutionary Computation 28.2 (June 1, 2020), pp. 255-288. doi: 10.1162/evco$_{a0}$0254.

Keywords: Optimal Recombination, Partition Crossover, Travelling Salesman Problem



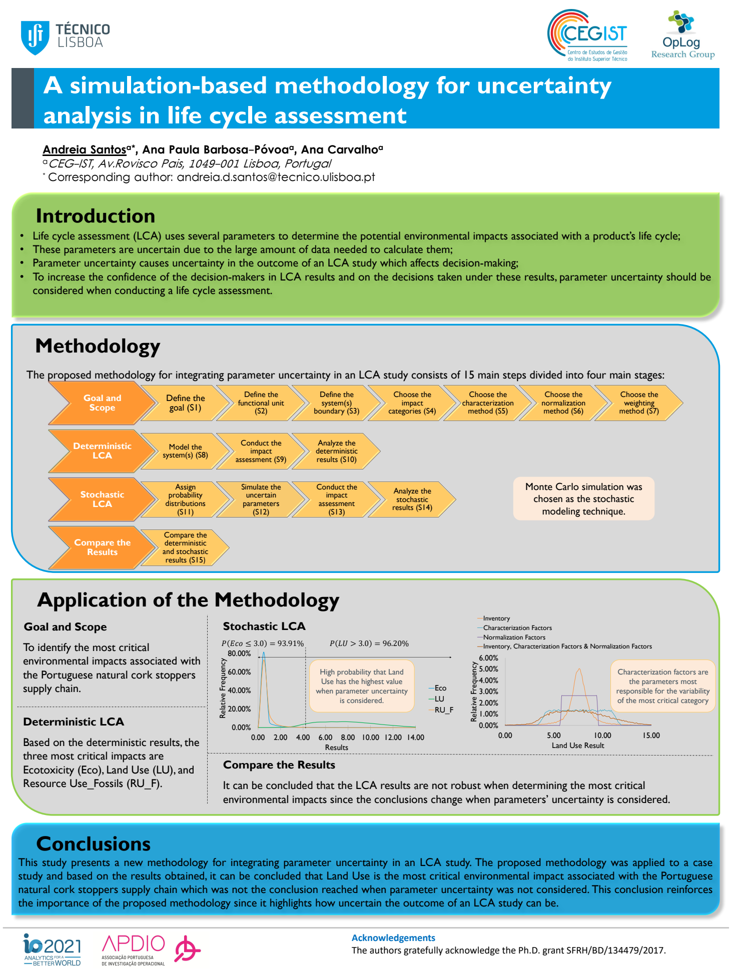
Submissão #69

A simulation-based methodology for uncertainty analysis in life cycle assessment

Andreia Santos, Ana Carvalho, Ana Barbosa-Póvoa

According to the European Commission, life cycle assessment (LCA) is the best methodological tool for assessing the potential environmental impacts associated with a product's life cycle. To determine the potential environmental impacts, different parameters are required which are calculated using data from several sources with different levels of reliability. The uncertainty associated with the data used causes the parameters utilized in an LCA to be uncertain and consequently, causes uncertainty in the outcome of an LCA study. To increase the confidence of the decision-makers in LCA results and on the decisions taken under these results, parameter uncertainty should be taken into account when conducting a life cycle assessment. This study presents a new methodology for integrating parameter uncertainty in an LCA study. This methodology involves conducting a traditionally deterministic LCA analysis that does not consider uncertainty, a stochastic LCA analysis, which considers the uncertainty associated with the different parameters, and a comparison of both analyses. The stochastic modelling technique applied in this study is Monte Carlo simulation. To illustrate how the developed methodology can be applied, this work presents the application of the developed methodology to the life cycle of Portuguese natural cork stoppers.

Keywords: Life cycle assessment, Uncertainty analysis, Monte Carlo simulation, Natural cork stoppers, Sustainable supply chain management



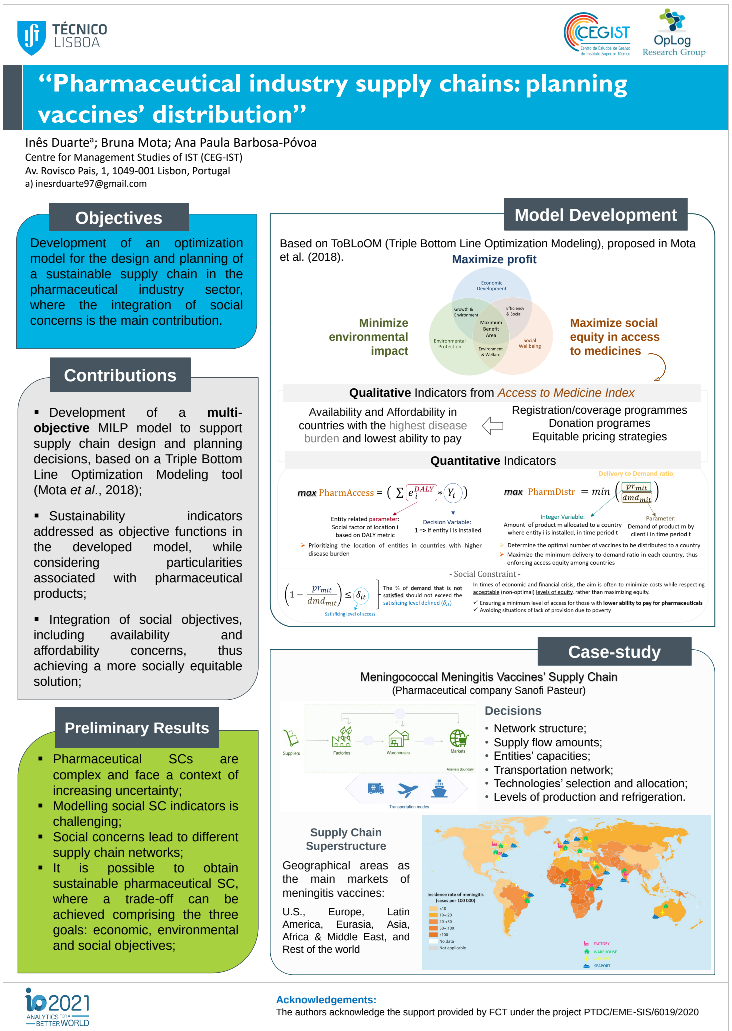
Submissão #70

Gestão da cadeia de abastecimento das vacinas: o projeto e planeamento da distribuição

Inês Duarte, Bruna Mota, Ana Barbosa-Póvoa

O planeamento e gestão das cadeias de abastecimento farmacêuticas é um processo complexo e enfrenta inúmeros desafios dadas as características únicas e exigentes da deste setor da indústria (Lemmens et al., 2016). Tornar estas cadeias de abastecimento mais sustentáveis, não só considerando objetivos económicos e ambientais, como também preocupações sociais é crucial. Em particular, incluir aspetos de equidade é de extrema relevância, no sentido de tornar estes produtos disponíveis e acessíveis a nível global (Menou, Hornstein and Lipton-McCombie, 2021). A ferramenta de apoio à decisão apresentada segue o trabalho desenvolvido por (Mota et al., 2018), onde um modelo multi-objetivo é proposto de forma a integrar decisões a nível estratégico e tático, considerando os três pilares de sustentabilidade. Este modelo foi aplicado a um caso de estudo real cujos resultados permitem avaliar diferentes cenários de otimização, bem como estudar a influência dos objetivos económicos, ambientais e sociais nas diferentes atividades presentes na cadeia de abastecimento. Desta forma, este trabalho propõe uma ferramenta que permite o projeto e planeamento das cadeias de abastecimento farmacêuticas, onde a integração de aspetos sociais constitui o grande foco e contributo.

Palavras chave: Cadeias de abastecimento farmacêuticas, Sustentabilidade, Equidade, Projeto e Planeamento



Submissão #71

An optimization approach to aggregate production planning with combined MTS-MTO production strategy

José Vila-Chã, Diogo Pereira da Silva, Daniel Pereira, Eduardo Ribeiro, Manuel Pina Marques

Production strategy definition and appropriate medium-term production planning are two crucial aspects to the success of industrial companies. A study was conducted in a company operating in the wine industry with two main objectives: finding the best production strategy for each product considering a hybrid make-to-stock/make-to-order production system and developing an optimization approach to aggregate production planning. The proposed approach for production strategy definition considers the impact that a change in the production strategy of one product has in the whole system by modeling congestion effects using M/G/1 queues. The process consists of a greedy heuristic that changes the production strategy of the product that, at each iteration, provides the highest savings. Once a strategy change occurs, costs and congestion effects of the whole system are recalculated, and the process is repeated until no more savings can be achieved. Regarding the aggregate production planning problem, an optimization model based on mixed-integer programming formulation was developed. With the goal of minimizing a global cost function, the model determines the most efficient and leveled allocation of production resources that meets the fluctuating demand. By applying the developed methodologies, the company is expected to achieve significant savings.

Keywords: Aggregate production planning, Make-to-order, Make-to-stock

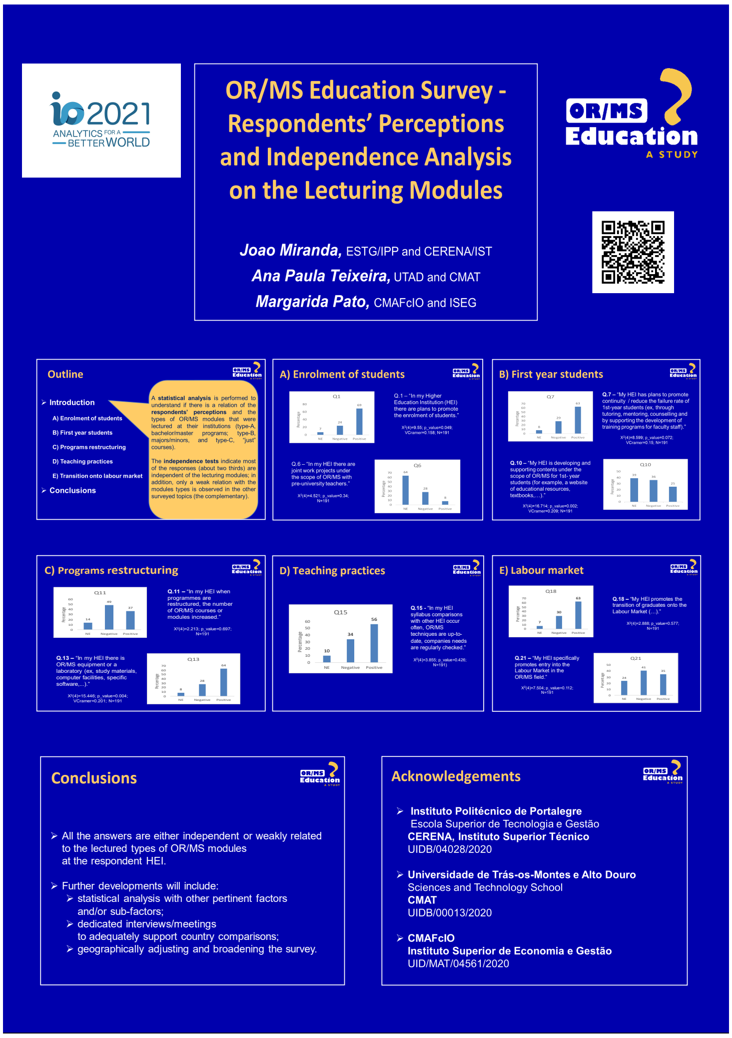
Submissão #72

OR/MS Education Survey - Respondents' Perceptions and Independence Analysis on the Lecturing Modules

Joao Luis de Miranda, Ana Paula Teixeira, Margarida Vaz Pato

This work addresses the respondents' perceptions in a survey conducted with the aim of learning from important developments in the European Higher Education area concerning the Operational Research/Management Science (OR/MS) field. The study regards, in particular: (i) the enrolment; (ii) the reduction in 1st year students' failure rates; (iii) the perceived value of OR/MS courses; (iv) the OR/MS teaching practices; and (v) the transition onto the labor market. A statistical analysis is performed to understand if there is a relation of the respondents' perceptions and the types of OR/MS modules that were lectured at their institutions (type-A, bachelor/master programs; type-B, separate majors/minors, and type-C, courses). The independence tests indicate most of the responses (about two thirds) are independent of the lecturing modules; in addition, only a weak relation with the modules types is observed in the other surveyed topics (the complementary). In this way, the respondents' perceptions are revisited, and further developments are discussed while addressing OR/MS Education within this evidence-based approach.

Keywords: OR/MS education, Enrolment, Retention, Restructuration, Teaching, Transition into labor market, Statistical analysis



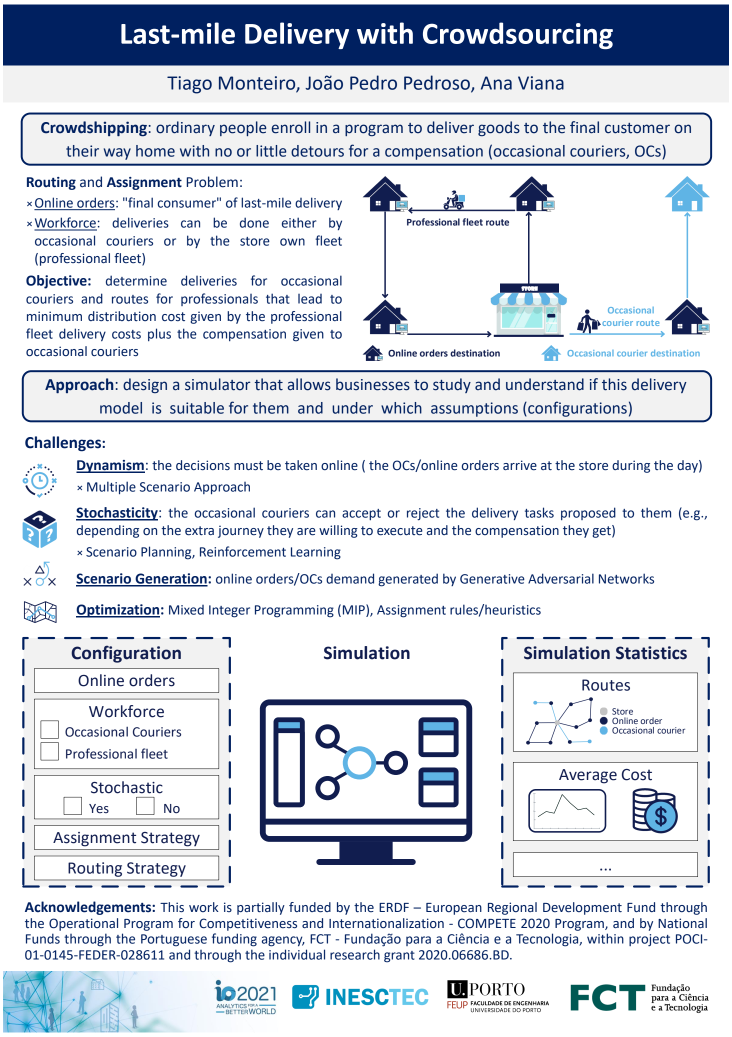
Submissão #73

Last-mile Delivery with Crowdsourcing

Tiago Monteiro, João Pedro Pedroso, Ana Viana

E-commerce has suffered a substantial increase in the last years. Customers buy more often online and expect quicker deliveries with smaller shipping fees. That represents a challenge for retailers that need to ensure service quality and efficiency over the multiple phases of the supply chain. We will study new models and algorithms to optimize the last phase of delivery of online purchases: last-mile delivery. In particular, we will exploit the concept of crowdsourcing in which, in addition to professionals, ordinary citizens (a.k.a. occasional couriers - OCs) participate in the delivery process. This problem combines two well-known problems in the literature: routing and matching. Parcels are matched with occasional couriers, and routes are generated for the company fleet and occasional couriers. For such a study, we develop a simulator that enables companies to understand how crowdsourcing can benefit them. Mainly, we aim to consider the stochasticity of potential occasional couriers when making decisions in terms of availability and the expected compensation. We further extend this work by incorporating machine learning/reinforcement learning tools into the simulator to evaluate diverse matching and compensation strategies and estimate their outcome.

Keywords: Last-mile Delivery, Crowdsourcing, Simulation, Machine Learning



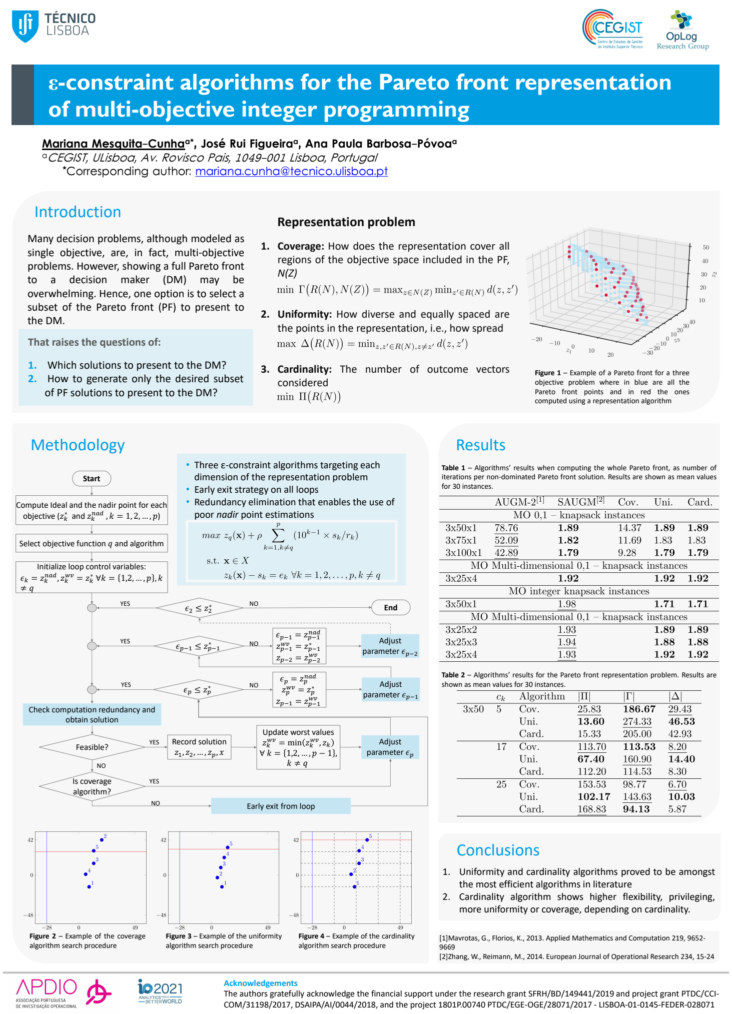
Submissão #74

ε-constraint algorithms for the Pareto front representation of multi-objective integer programming

Mariana Mesquita-Cunha, José Rui Figueira, Ana Barbosa-Póvoa

Many decision problems, although sometimes modeled as single objective, are, in fact, multi-objective problems. However, showing a full Pareto front to a decision maker may be overwhelming. Hence, one option is to select a subset of the Pareto front to present to the decision maker. Nevertheless, that raises the questions of which solutions to present to the decision maker and, furthermore, how can we focus on generating only the desired subset of Pareto front solutions. Considering that a good subset of solution is one where the uniformity, coverage and cardinality of the subset are considered, three generation algorithms based on the ε-constraint method that address each of those concerns are put forward. Additionally, the algorithm that targets the subset's cardinality and the one that focuses on uniformity present procedures that skip the search for redundant solutions. Finally, all three algorithms are insensitive to the quality of the estimation of the Pareto front extremes. Results show that the proposed algorithms, apart from generating representations of the Pareto front, are also competitive when generating the full Pareto front.

Keywords: Multi-objective generation method, ε-constraint, Integer programming, Generation method



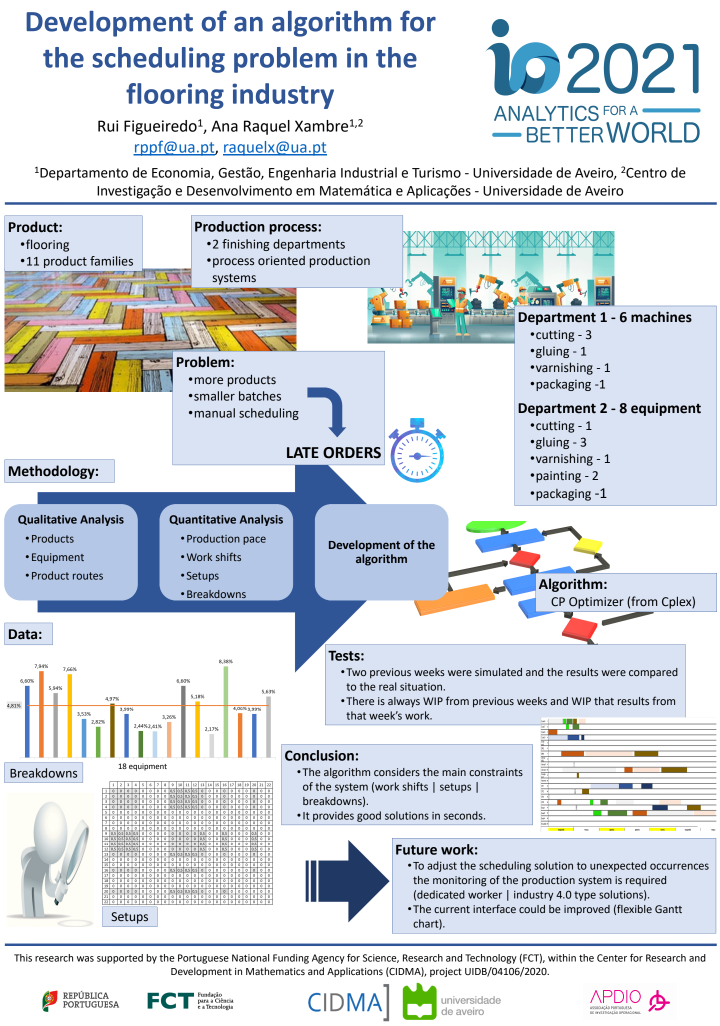
Submissão #75

Development of an algorithm for the scheduling problem in the flooring industry

Rui Figueiredo, Ana Raquel Xambre

This work was developed in a flooring industry that is currently facing an increase of product variety and a decrease of batch sizes. This high mix-low volume environment has led to a higher complexity of the production system and made intuitive scheduling more difficult. As such, a scheduling algorithm adapted to the needs of the company was developed in order to obtain, in a more formal and logical way, a solution to the scheduling problem. First, an analysis of the production system was carried out which helped to identify the factors that should be considered, namely: products, routes, production pace, setup times, work shifts and breakdowns. On a second stage, the structure of the procedure was designed taking into account that it should integrate the aforementioned factors. In the validation stage, two weeks of production were chosen and the scheduling was simulated. The objective of the work was achieved, the algorithm was developed and is operational for the reality of the company. Even so, given the complexity of a scheduling system for this type of environment, improvements were identified, namely making the algorithm more flexible to user inputs, and improving the interaction platform.

Keywords: Scheduling, High mix-low volume, Algorithm



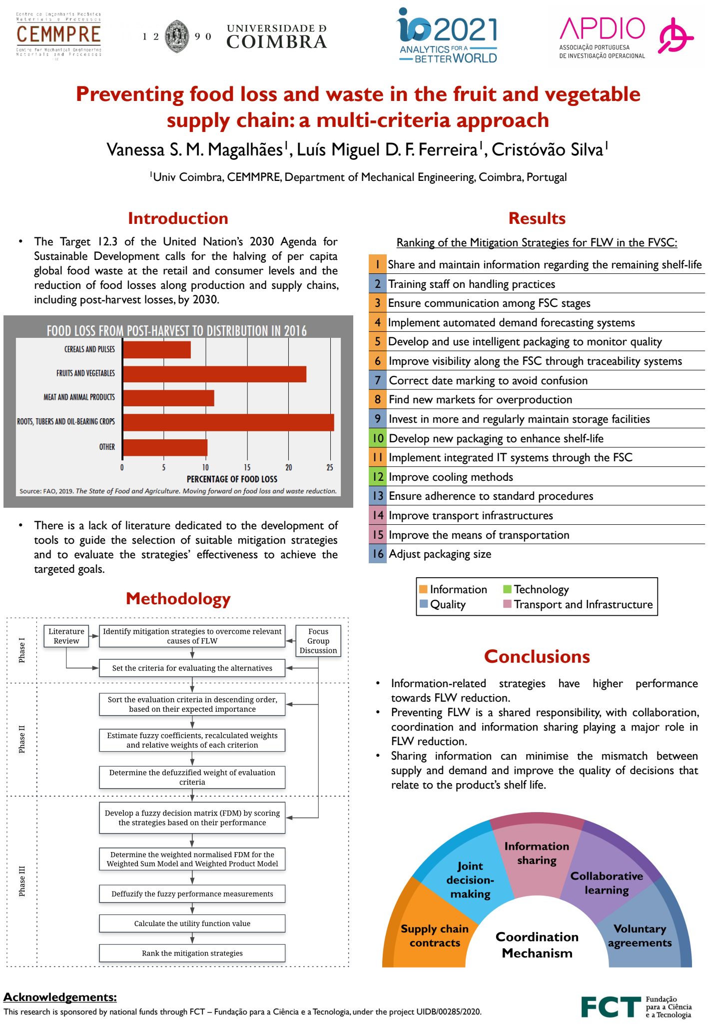
Submissão #76

Preventing food loss and waste in the fruit and vegetable supply chain: a multi-criteria approach

Vanessa Magalhães, Luis Ferreira, Cristóvão Silva

Reducing food loss and waste (FLW) is a global concern, but little research has been performed to develop tools to guide the selection of suitable mitigation strategies and to evaluate the strategies? effectiveness to achieve the targeted goals. Therefore, this study develops and presents a three-phase evaluation framework to identify, evaluate and rank potential mitigation strategies to fight FLW. The framework was tested in the context of the Portuguese fruit and vegetable supply chain (FVSC). In the first phase, a literature review is performed and focus group discussions (FGD) are used to identify potential strategies to tackle the causes of FLW experienced in the FVSC. The second phase uses the fuzzy Step-wise Weight Assessment Ratio Analysis (SWARA) method to determine the relative weights of the evaluation criteria for FLW mitigation strategies. Finally, in the third phase, the fuzzy weighted aggregated sum product assessment (WASPAS) is used to rank the mitigation strategies. Results show that preventing FLW is a shared responsibility, highlighting the role of collaboration, coordination and information sharing towards the prevention and reduction of FLW. Overall, this paper provides researchers, practitioners and policymakers with a structured approach to prioritise cost effective efforts with higher environmental and social gains.

Keywords: Food Loss and Waste, Fruit and Vegetable Supply Chain, Mitigation Strategies, Fuzzy Step Wise Weight Assessment Ratio Analysis, Fuzzy Weighted Aggregated Sum Product Assessment



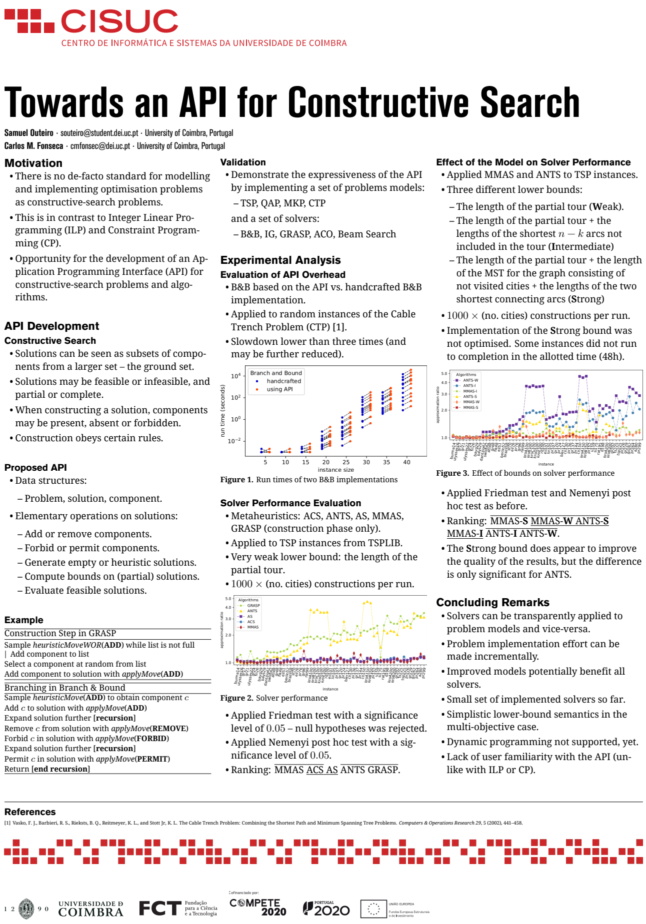
Submissão #77

Towards an Application Programming Interface for Constructive Search

Samuel Outeiro, Carlos M. Fonseca

Optimisation practice is intimately related to the availability of software tools to support it. Current approaches to combinatorial optimisation typically fall into one of two broad classes: glass-box mathematical programming formulations and solvers, such as integer linear programming (ILP) and constraint programming (CP), and black/grey-box problem models and (usually heuristic) algorithms implemented directly in software. The latter may be more flexible and easier to integrate into existing workflows, but the lack of a de-facto standard for modelling/implementing optimisation problems in software hinders its adoption in practice. In fact, different optimisation software frameworks usually require problems to be implemented in that framework. In addition, most such frameworks strongly emphasise local search algorithms over constructive search. The development of an Application Programming Interface (API) for constructive search problems and algorithms is the main focus of this work. The problem formulation is separated from the algorithm that solves it by specifying a number of abstract elementary operations that problems must implement and solvers can use in a problem-independent way. Both exact and (meta-)heuristic algorithms are supported, including Branch and Bound, Beam Search, GRASP and Ant Colony Optimisation algorithms, among others. A discussion of the implications of the proposed abstraction for the development of novel constructive search algorithms concludes the presentation.

Keywords: Constructive Search, Combinatorial Optimisation, Software



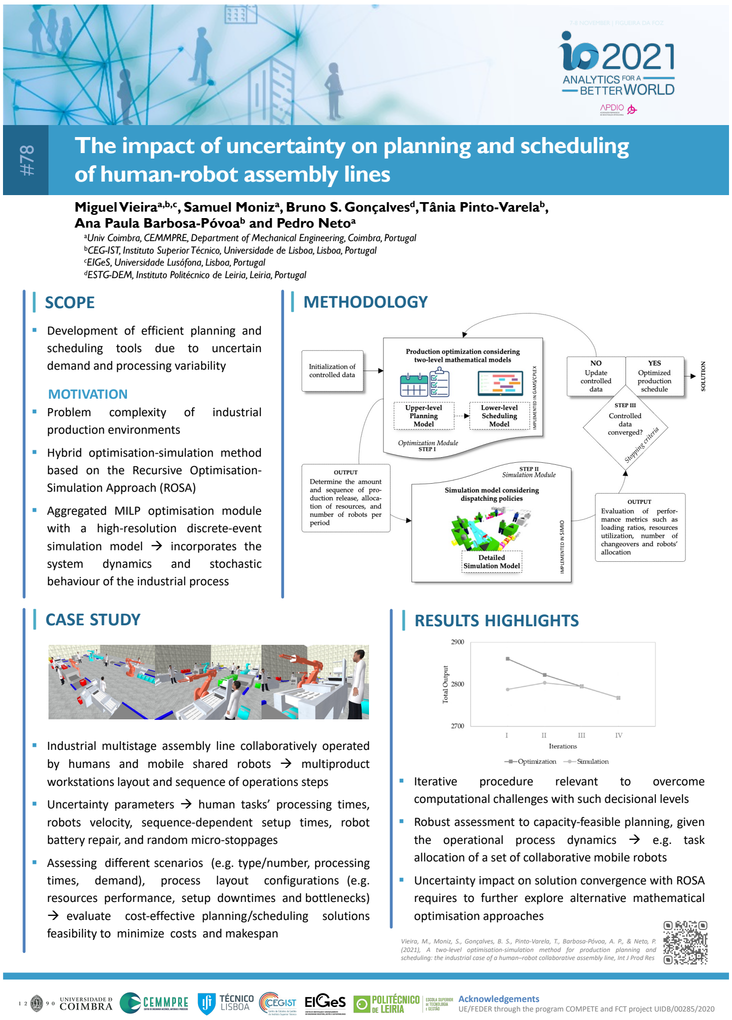
Submissão #78

The impact of uncertainty on planning and scheduling of human-robot assembly lines

Miguel Vieira, Samuel Moniz, Bruno S. Gonçalves, Tânia Pinto-Varela, Ana Barbosa-Póvoa, Pedro Neto

The complexity of production environments due to uncertain demand and processing variability have been recognised as a common problem in the development of efficient planning and scheduling tools. In this work, we explore an optimisation-simulation method based on the Recursive Optimisation-Simulation Approach (ROSA) to provide decision-support for integrated production planning and scheduling, combining a mathematical optimisation module with a high-resolution discrete-event simulation model. The advantage of this iterative approach is that the simulation can incorporate the system dynamics and stochastic behaviour, reducing the optimisation problem hindrance by leaving some of the hard-to-model constraints for the later. Through an industrial case study of a multistage assembly line collaboratively operated by humans and mobile shared robots, the work focusses on the advantages of the hybrid approach in the definition of planning and scheduling solutions, given a process layout with available workstation resources to produce a set of products with a defined sequence of operations steps. We highlight the overall impact of the uncertainty parameters integration in the methodology in order to guarantee capacity-feasible solutions, given the assessment of the operational process dynamics.

Keywords: production planning and scheduling, optimisation-simulation method, uncertainty



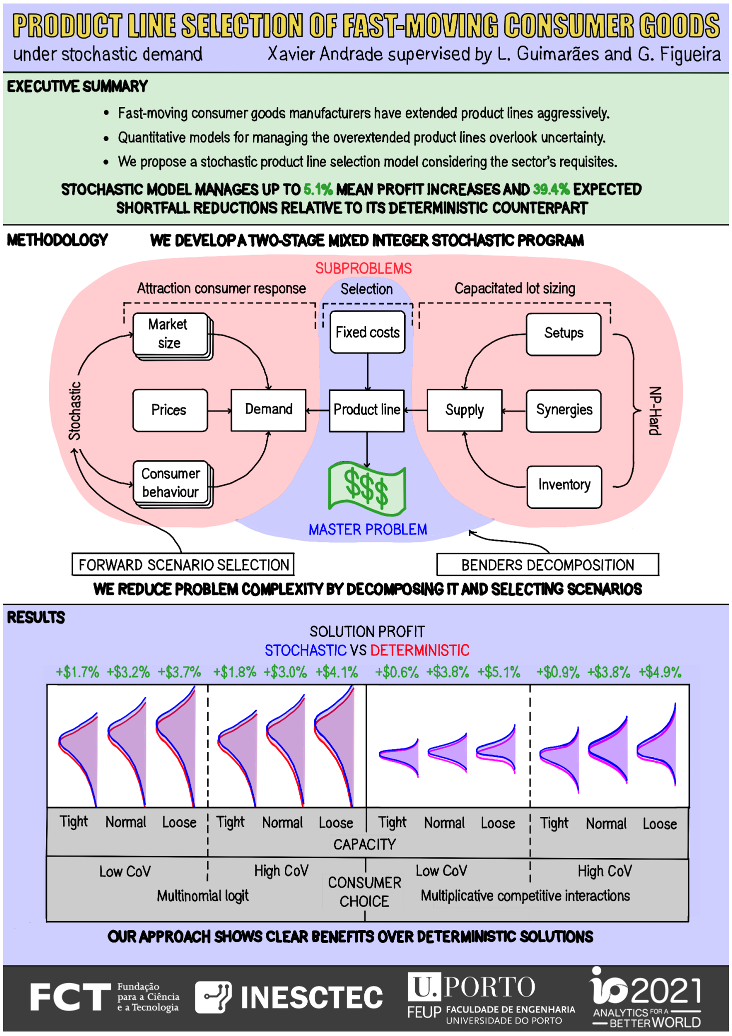
Submissão #79

Product line selection of fast-moving consumer goods under stochastic demand

Xavier Andrade, Luis Guimarães, Gonçalo Figueira

Selecting fast-moving consumer goods product lines requires deep insight into projected production costs and demand volumes, given the sector's thin margins. Demand volumes are difficult to estimate, because both the total market size and each individual product utility are subject to considerable uncertainty. This paper tackles product line selection for fast-moving consumer goods producers, incorporating market sizes and product utility uncertainty. We propose a stochastic formulation to determine profit-optimizing product lines. Sequentially, our approach makes a selection and, when demand reveals itself, computes complexity costs by solving a capacitated lot-sizing problem. We address this model's complexity on two fronts: using Bender's decomposition and reducing the number of scenarios to consider. The decomposition method drastically cuts solution times, particularly for instances with small subproblems. The scenario reduction procedure achieves equivalent stability to random draws using almost one-third of the scenarios. Lastly, we analyze the value of the stochastic solutions under different random utility models, attractiveness coefficients of variation, and capacity conditions. The stochastic approach leads to clear benefits in expected profit, managing up to 5.1% mean profit increases and 39.4% expected shortfall reductions compared to deterministic solutions.

Keywords: Product line selection, Stochastic programming, Multinomial logit, Multiplicative competitive interaction, Lot sizing



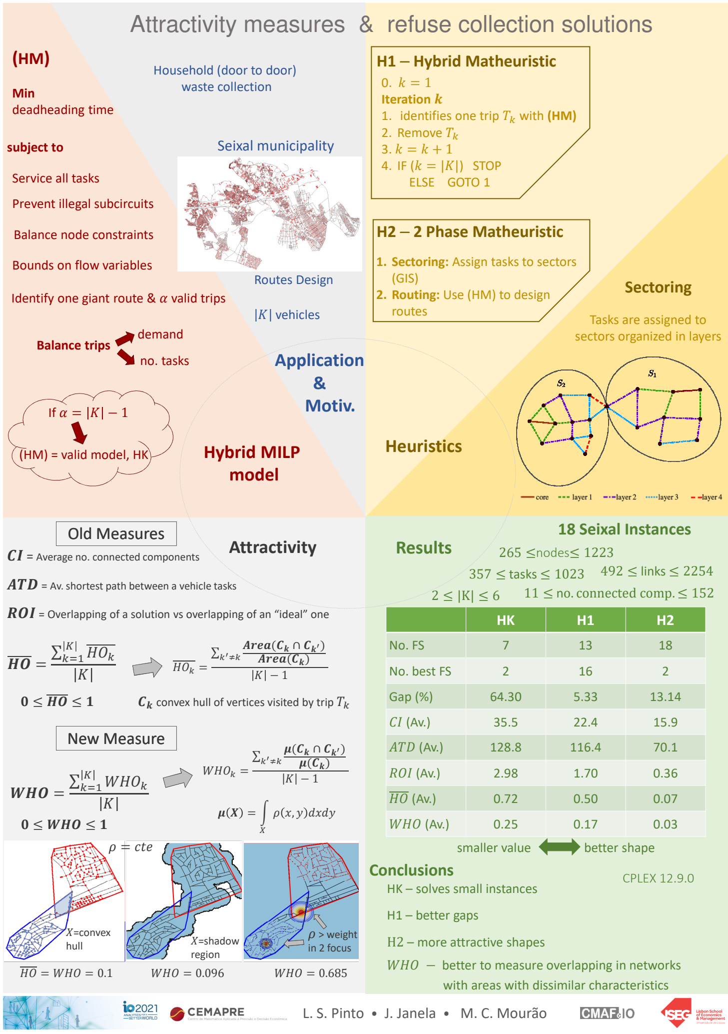
Submissão #80

Attractive measures refuse collection solutions

Leonor Santiago Pinto, João Janela, Maria Cândida Mourão

Refuse collection solutions are usually validated through the total time. We propose an attractive measure that aim to evaluate the solutions' fitness to address a real case study. Solutions are gathered by hybrid matheuristics compared with the ones obtained by a mixed integer linear programming model for a mixed capacitated arc routing problem. This study was motivated by a household waste collection system in the Portuguese municipality of Seixal. The GIS tool, available at the municipality, is used not only for the input/output but as an alternative method to design sectors as it provides spatial information. The methods developed and the model are tested on real based instances and the results of that computational experience reported and analyzed including attractiveness measures.

Keywords: Attractiveness measures, Mixed capacitated arc routing, Matheuristics, GIS



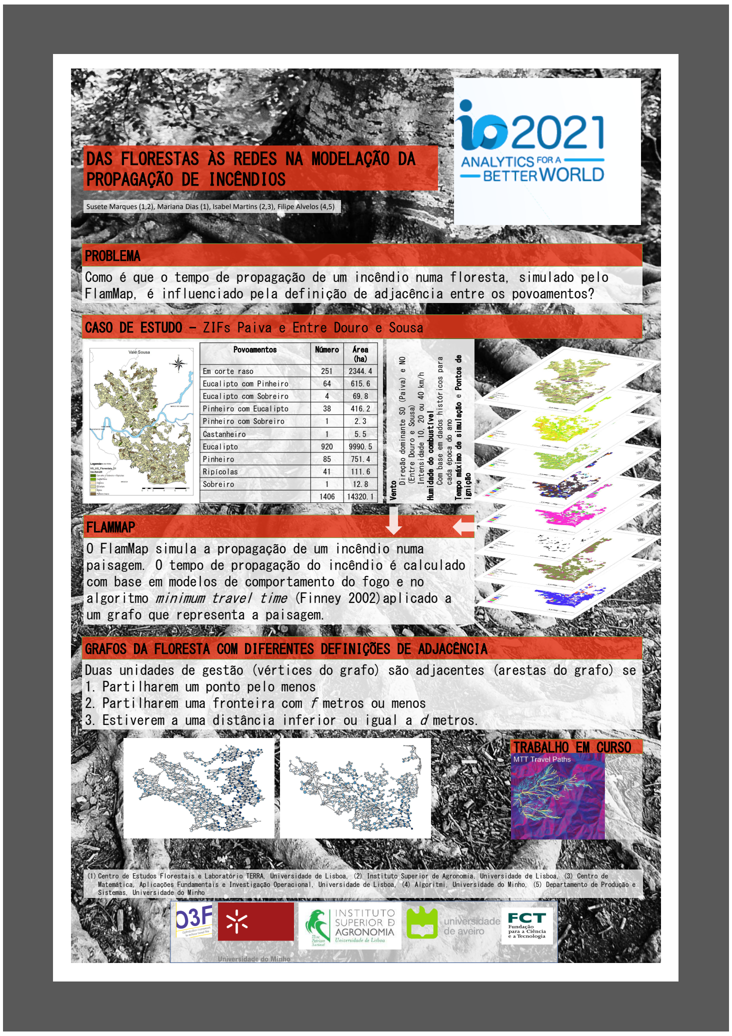
Submissão #81

Das florestas às redes na modelação da propagação do fogo

Susete Marques, Mariana Dias, Isabel Martins, Filipe Alvelos

Os principais modelos de propagação do fogo à escala da floresta baseiam-se na representação da paisagem como uma rede em que os nodos correspondem a células e os arcos a relações de adjacência. Naturalmente, diferentes definições das células e das relações de adjacências conduzem a diferentes redes, quer em termos de estrutura, quer em termos de dimensão. Neste trabalho, propõem-se abordagens de definição de redes tendo em conta a relação entre a granularidade das células, definições de adjacência e influência nos modelos de propagação de fogo, utilizando o software Flammap. Este trabalho foi realizado no âmbito PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire"financiado pela FCT, Fundacão para a Ciência e Tecnologia.

Palavras chave: Modelos de propagação do fogo, Redes, Flammap



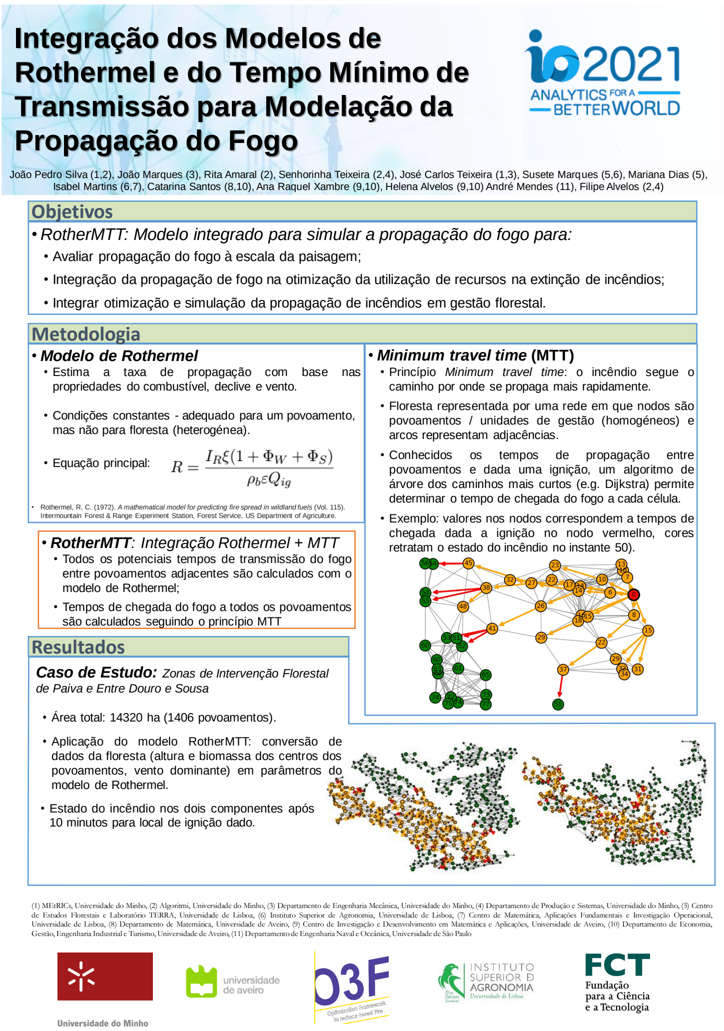
Submissão #82

Integração dos modelos de Rothermel e do tempo mínimo de transmissão para modelação da propagação do fogo

João Pedro Silva, João Marques, Rita Amaral, Senhorinha Teixeira, José Carlos Teixeira, Susete Marques, Mariana Dias, Isabel Martins, Catarina Santos, Ana Raquel Xambre, Helena Alvelos, André Mendes, Filipe Alvelos

Incêndios florestais são classificados como fenómenos complexos, com dimensões de tempo e espaço que variam numa escala de segundos e milímetros a mais de um dia e mais de um quilómetro. Quando ocorre em florestas, o fogo pode ter um enorme impacto nos seres humanos, pois coloca a vida e propriedades em perigo. Portugal foi o único país dos Estados Membro da União Europeia com um decréscimo da área florestal nas últimas três décadas. Os incêndios florestais são a razão por detrás desta redução, o que faz com que a gestão do combustível florestal, e da floresta em geral, seja fundamental para evitar danos no ecossistema. Neste sentido, prever este fenómeno é de grande importância para a tomada de decisões na prevenção e combate. Deste modo, propõe-se a integração do modelo de Rothermel no modelo do tempo mínimo de transmissão. Este último representa a paisagem como uma rede, com tempos de transmissão do fogo associados aos arcos, e determina o tempo de chegada do fogo a qualquer ponto da rede de forma eficiente através de um algoritmo de caminhos mais curtos (e.g. algoritmo de Dijkstra). Neste trabalho exploram-se modelos de propagação do fogo em que os tempos de transmissão nos arcos da rede do tempo mínimo de propagação são obtidos com o modelo de Rothermel. Este trabalho foi realizado no âmbito PCIF/GRF/0141/2019 "O3F - An Optimization Framework to reduce Forest Fire"financiado pela FCT, Fundacão para a Ciência e Tecnologia.

Palavras chave: Incêndio Florestal, Modelação Matemática, Rothermel



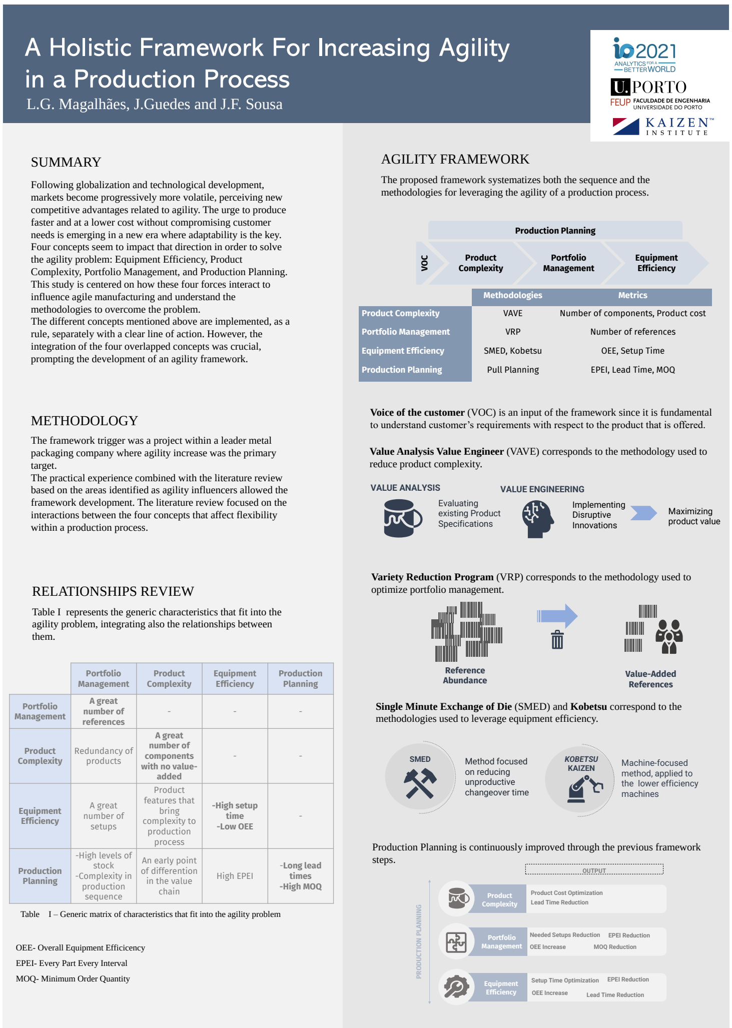
Submissão #83

A Holistic Framework for Increasing Agility in a Production Process

Leonor Magalhaes, João Guedes, Jorge Freire

Following the globalization and technological development, markets become progressively more volatile and dynamic, perceiving new competitive advantages related to agility. The urge to produce faster and at a lower cost, without compromising customer needs, is emerging in a new era where adaptability is the key. Thus, this study focuses on the development of an agility framework. A project within a leader metal packaging industry worked as the framework trigger. Agility increase was the main target, where production line flexibility leverage and equipment efficiency optimization were also contemplated. However, different barriers to agility were unveiled. To solve the agility problem, four concepts seem to have an impact in that direction, such as Equipment Efficiency, Product Complexity, Portfolio Management and Production Planning. This paper is centered in how these four forces interact to influence an agile manufacturing and in understand the methodologies to overcome the problem. The different concepts mentioned above are implemented, as a rule, separately with a clear line of action. However, in the context of the project, the integration of the four overlapped concepts was crucial, prompting the development of an agility framework that will be presented in this study.

Keywords: Agility, Overall Equipment Efficiency, Production Planning, Product complexity



Submissão #84

Seller-buyer supply chain: A game theory framework

João P. Almeida, Carla A. S. Geraldes, João P. Coelho

We present a game theoretical framework to study competition and collaboration scenarios in seller-buyer supply chains, representing a manufacturer that wholesales a product to a retailer who, in turn, retails to the final consumer. We study cooperative and non-cooperative scenarios, by considering in the first case a Stackelberg game under both the situations where one of the players, either the buyer or the seller, plays the leading role by taking the initiative and forcing the strategy of the other player, the follower. In the cooperative game, we analyse scenarios where the profit of both players are increased when applying joint cooperative strategies. We also compute the Nash equilibria. This is undergoing work.

Keywords: Seller-buyer supply chain, Game theory, Stackelberg game, Nash equilibrium

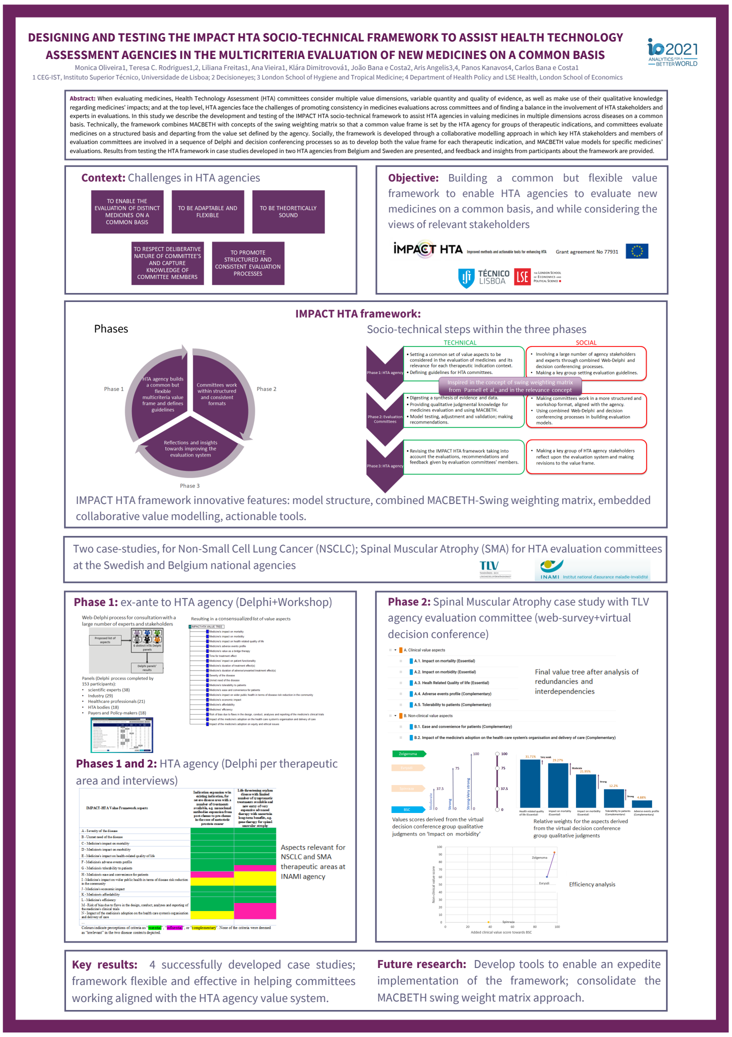
Submissão #86

Designing and testing the IMPACT HTA socio-technical framework to assist HTA agencies in the multicriteria evaluation of new medicines on a common basis

Mónica Oliveira, Teresa Rodrigues, Liliana Freitas, Ana Vieira, Klára Dimitrovová, João Bana e Costa, Aris Angelis, Panos Kanavos, Carlos Bana e Costa

When evaluating medicines, Health Technology Assessment (HTA) committees consider multiple value dimensions, variable quantity and quality of evidence, as well as make use of their qualitative knowledge regarding medicines' impacts; and at the top level, HTA agencies face the challenges of promoting consistency in medicines evaluations across committees and of finding a balance in the involvement of HTA stakeholders and experts in evaluations. In this study we describe the development and testing of the IMPACT HTA socio-technical framework to assist HTA agencies in valuing medicines in multiple dimensions across diseases on a common basis. Technically, the framework combines MACBETH with concepts of the swing weighting matrix so that a common value frame is set by the HTA agency for groups of therapeutic indications, and committees evaluate medicines on a structured basis and departing from the value set defined by the agency. Socially, the framework is developed through a collaborative modelling approach in which key HTA stakeholders and members of evaluation committees are involved in a sequence of Delphi and decision conferencing processes so as to develop both the value frame for each therapeutic indication, and MACBETH value models for specific medicines' evaluations. Results from testing the HTA framework in case studies developed in two HTA agencies from Belgium and Sweden are presented, and feedback and insights from participants about the framework are provided.

Keywords: Multicriteria Decision Analysis, Health Technology Assessment, Socio-Technical Approaches, MACBETH, Collaborative Value Modelling



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